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UNIVERSITY OF ALBERTA

Psychosocial Correlates of TMD in Adolescents

by

Cynthia Blackman

A THESIS
SUBMITTED TO THE FACULTY OF GRADUATE STUDIES AND
RESEARCH IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY

Department of Educational Psychology

EDMONTON, ALBERTA
Fall, 1990

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Date 1st October, 1990

DEDICATION

This work is dedicated to my husband,

Maurice,

who has been both my guide and mentor, and without whose constant encouragment and support this could not have happened.

ABSTRACT

The present research explored the relationship between the psychosocial correlates of TMD in adolescence. The objectives of the study were to (a) understand the psychological precursors of TMD, (b) to develop criteria to identify those individuals at risk for TMD, (c) identify subgroups of TMD sufferers and, (d) to enhance treatment planning. The study also attempted to develop a theoretical framework for TMD disorder using an interactional biopsychosocial paradigm, stressing the links between stress, personality, psychopathology, and social support at the onset of TMD in adolescents.

The seventy adolescents who participated in the study all completed a series of questionnaires which included such variables as referring symptoms, school, social, and family interactions. They also completed a battery of standardized assessment instruments including the Basic Personality Inventory, The Multidimensional Assessment of Life Events, The Intellectual Achievement Responsibility Scale, and The Symptom Severity Index. Clinical examination results were recorded on the Craniomandibular Index. Multiple analysis were then carried out using various statistical methods.

It was found that two types of TMD in adolescents could be differentiated based on the results of the Craniomandibular Index and Basic Personality Inventory. The first was a primarily physical condition with jaw pain and joint dysfunction, with few psychosocial correlates. The second involved high levels of muscle tenderness and was associated with increased anxiety, depression, hypochodriasis, and multiple pain complaints suggesting underlying emotional difficulties.

The outcome of the study was limited by a number of factors including small sample size, heterogeneity of subjects despite the narrow age range, and the large number of variables recorded. The research did support the relationship of some psychosocial variables including multiple pain complaints, hypochodriasis, depression and anxiety. It did not support the influence of life stress on TMD in adolescence. Post hoc Power Analysis suggested that very large sample sizes would be required to assess any significant relationships between stress and TMD in adolescence.

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I. INTRODUCTION

Background to the Study;

Temporomandibular Dysfunction (TMD), is the term used to describe a heterogenous group of disorders affecting the temporomandibular joint and the muscles of mastication. It is characterized by unilateral or bilateral pain over the temporomandibular joint, tenderness on palpation of the muscles of mastication. It may be accompanied by clicking and popping sounds on movements of the temporomandibular joint, and limitations and deviations in joint movement. In TMD patients the various symptoms and signs may occur separately or in combination. TMD may occur without joint derangement and present as facial, neck, and head pain only. Alternatively TMD may be associated with degenerative and arthritic changes in the TMJ joints. It is often the debilitating pain rather than the physical signs of jaw dysfunction that bring the patient for treatment. Treatment is generally conservative and may involve the provision of dental splints to stabilize the jaw, physiotherapy, chemotherapy and/or relaxation training, and biofeedback to relieve muscle tension. In treatment resistant cases oral surgery may be required repair.

TMD originally perceived as a physical disorder, is now considered to have a multi-factorial basis involving physical, pathological, psychological, and social correlates. Numerous attempts have been made to provide an etiological paradigm for this condition, but so far no single theoretical approach has been satisfactory (Moss & Garrett, 1984).

The treatment of TMD also reflects its multi-dimensional nature. The majority of patients seem to respond well to conservative physical treatment, whether or not specific psychological treatments are included. However, a small proportion of sufferers are resistant to conservative dental treatment and may be subject to more radical surgical intervention, often with limited improvement (Ash, 1986). These patients may represent a subgroup of TMD sufferers who may place great demands on the health care system, due to the chronicity of their condition.

There are a number of factors which make the diagnosis and treatment of TMD difficult and which prompted the present study. These may be presented under five headings: (a) problems with nomenclature and classification, (b) epidemiological findings, (c) problems defining the influence of stress and other psychosocial variables, (d) the problem of generalizing from data obtained from different age groups, and (e) difficulties separating symptoms and signs related to TMD from those secondary to chronicity.

These problems will be considered in some detail below.

1. There is no universally accepted nomenclature to define TMD, and the term TMD covers a wide range of symptoms and signs related to the temporomandibular joint and the associated musculature. This varies from generalized facial and head pain without localizing signs, to actual degenerative changes in the temporomandibular joint. Many studies have failed to classify these subgroups adequately, making interpretation of research results difficult to generalize.
2. In an epidemiological study Speculand and Goss (1985) reported that approximately 88% of the adult population have, or have had symptoms of TMD. Although 25% of these individuals have severe symptoms, only a very small proportion, less than 5%, actually attend for treatment. This suggests that there is something more than

the TMD itself which precipitates the search for help (Speculand & Goss, 1985).

3. Recently the effects of psychological factors have been implicated in the etiology of TMD. These have included (a) studies of specific personality types, (b) the influence of life stress, (c) psychological and psychosocial competence, (d) illness and wellness behavior and psychopathology, including (e) specific psychiatric disorders. Although many studies have been carried out, agreement as to the direct influence of any or all of these areas on TMD remains unproven. The majority of the studies have failed to satisfy, as they tend to seek uni-causal explanations that incorporate methodological and sampling problems (Warman, Weidman & Arnold, 1983).
4. Since TMD can occur over a wide age range, from infancy to late adulthood, it is doubtful that the same psychological and psychosocial factors would apply throughout all age ranges (Franklin, Smith, Catlin, Helfrick & Foster, 1986).
5. The majority of TMD studies have been carried out in the adult age group, often with patients

> that have been chronic for many years. Since TMD is thought to be a progressive disease, it may be that the factors identified with etiology in this age group, including life stress and psychopathology, may be symptomatic of chronic illness, including a chronic pain syndrome, rather than of TMD itself.

Psychological speculation into the etiology of TMD has involved examination of personality variables, psychopathology, stress, and psychosocial functioning. TMD was first linked to psychological factors by Moulton (1955), who suggested that TMD occurred as a conversion reaction, or displacement of emotional conflict that had been repressed. Attempts were also made to relate TMD to personality types using the MMPI and other personality measures (Eversole, Stone, Matheson & Kaplan, 1985; Speculand & Goss, 1985; Warman et al, 1983). These studies have produced equivocal results, and generally personality differences between TMD sufferers and controls have not been significant.

TMD has also been associated with specific psychopathology, especially depression. Fine (1971) found that TMD patients had significantly more psychopathology than adult controls. TMD has also been related to specific psychiatric disorders, including hypochondriasis, somatization disorder, conversion disorder, and factitious disorder (Fine, 1971; Kydd, 1959; Lefer, 1966). Dworkin, Von Korff & LeResche (1990) suggested that the chronic pain associated with TMD might represent a depressive equivalent, and that the chronic pain syndrome produced was similar to other chronic pain syndromes.

Stress and its relationship to TMD has also been studied extensively and has produced the most plausible link to TMD. However, there is some controversy as to whether the increased stress found in many adult TMD patients is the cause of the condition or secondary to the condition itself. Numerous studies have found associations between stress and TMD, in experimental and clinical samples. These studies have used both electro-physiological measures of muscle stress, and various life stress measures (Geissler, 1985; Laskin, 1969; Lundeen, Sturdevant & George, 1987; Mercuri, Olson & Laskin, 1979; Schwartz, 1956; Stein, Loft, Davis & Hart, 1982; Yemm, 1969a, 1969b, 1969c).

Further proof of a possible connection between TMD and psychological factors stems from treatment studies, especially with the non-responsive group to conservative dental management. Psycho-therapeutic and behavioral approaches have been attempted with some success, including biofeedback and relaxation therapy, indicating that stress is, indeed, an important part of TMD etiology (Funch & Gale, 1984; Scott & Gregg, 1980).

Modern society imposes significant day-to-day stress on the individual. Hurrelmann (1989) stated that "...the potential for individuality has increased to a degree unprecedented in our history" (p. 2). However, most research on stress has focused on uni-causal explanations using linear uni-dimensional models that have not differentiated or explained why some people may succumb to and others are able to withstand stress. Stress in itself has been shown to effect the immune system, and can worsen any illness, regardless of cause (Camara & Danoa, 1989). However, individuals differ in their ability to cope with stress, and mediating factors apparently determine the amount of stress an individual can withstand before there is system breakdown. Elliott and Eisendorfer (1982) suggested a paradigm for studying stress-related illness that included four parameters: (1) potential activators, causing (2) reactions, that lead to (3) consequences, depending on (4) mediating factors. Activators referred to the actual stressors, their measurement, and inter-relationships. Reactions included physiological, biochemical, and psychosocial processes. The consequences of the stress activation and reaction could then be measured by examination of the consequences, either in health change or actual illness induction. The last parameter outlined by these authors is mediating factors. These were specific modifying variables that influenced whether an individual would be able to withstand the particular stress, or would indeed decompensate. For example, in some individuals, protective mediating factors include good self-esteem, high pain threshold, effective coping mechanisms, the ability to deal with life stress, and the absence of concomitant psychopathology. These authors concluded that good protective factors would assist the individual in resisting stress, while high risk factors would make them more sensitive to stress.

In summary, despite a considerable body of knowledge gained over the last 50 years or so, TMD remains a complex and poorly understood problem, which has defied uni-causal explanatory models of etiology. This is, perhaps, not surprising in a heterogeneous disorder which may present in so many different ways. It may be more realistic to assume that TMD represents a spectrum of disorders which may be purely physical or purely psychological in origin, responding to fairly straightforward physical or psychological treatments. Alternatively it may present a more complex and multifaceted etiology, including mixed physical and psychological factors that require more sophisticated multi-disciplinary approaches to treatment, including both physical and psychological therapies.

This preliminary discussion, indicates that further research is still needed to better understand the nature of TMD. It is particularly important to define psychological and psychosocial variables which might effect treatment and diagnostic criteria.

Significance of the Study

In this study it was hypothesized that TMD could best be understood using a bio-psychosocial model that emphasized the interaction between biomedical, psychological, and socio-cultural correlates effecting the individual. In this model TMD was conceptualized as the end product of the interaction of these variables. In a predisposed individual, some particular event triggers a stress reaction, which in turn activates a physiological response, involving increased autonomic arousal. This leads to sensitization of a previously dysfunctional or vulnerable tissue; in this case the temporomandibular joint and/or associated musculature. This in turn leads to muscle spasm and pain, and may also cause problems in joint movement (Laskin, 1969). Psychological factors may intervene, either serving to ameliorate the stress or worsen it. These include attitudes to illness, capacity for somatization, perceived family and community support, personality factors including self-esteem, locus of control, and emotional dysfunction (Marbach, Lennon & Dohrenwend, 1988). Failure to treat the problem may result in chronicity including chronic pain, which may in itself induce psychological reactions and worsen the already present disease process.

Life stress in itself, does not seem sufficient to cause TMD. There are a number of psychological factors as outlined above, that may vary the expression of the TMD syndrome, including severity and chronicity. These mediating factors might also have a role in differentiating those patients who might respond to conservative treatments, and those who are unresponsive (Salter, Brooke, Merskey, Fichter & Kapusianyk, 1983).

In summary, successful treatment of TMD is hampered by the problems of diagnosis, especially the differentiation of patients who will require more intensive psychological and physical treatment. If it can be established that TMD can be classified on the basis of an integrated multidiscplinary model, then it may be possible to better plan definitive treatments based on the patient's individual needs.

TMD has been described at all ages from birth through to adulthood (Belfer & Kaban, 1982). However, psychosocial research on TMD has mainly concentrated on heterogeneous adult populations of varying chronicity, and generalizations have been made that may not apply equally to all age groups, or to acute versus chronic presentations.

It might be possible to identify in adolescents with TMD of recent onset, patients in whom psychological factors including psychopathology precipitated the onset of TMD, from those patients whose illness is purely physical in origin, and from more complex TMD disorder with both psychological and physical etiological factors. Successful differentiation at an early age might assist in the development of preventative psychological and/or physiological treatments. It might also assist in determining whether the psychosocial variables associated with TMD are etiologically significant, or whether such factors are secondary to chronic pain and disability. By identifying stress factors and problems with psychosocial adjustment at an early age, it might be possible to identify those individuals at high risk for stress related illness, and implement earlier intervention programs.

Purpose of the Study

Recent findings on stress and illness are integrated in this study to form a model of psychological and psychosocial correlates of TMD. Based on the TMD literature, the following generalization can be suggested:

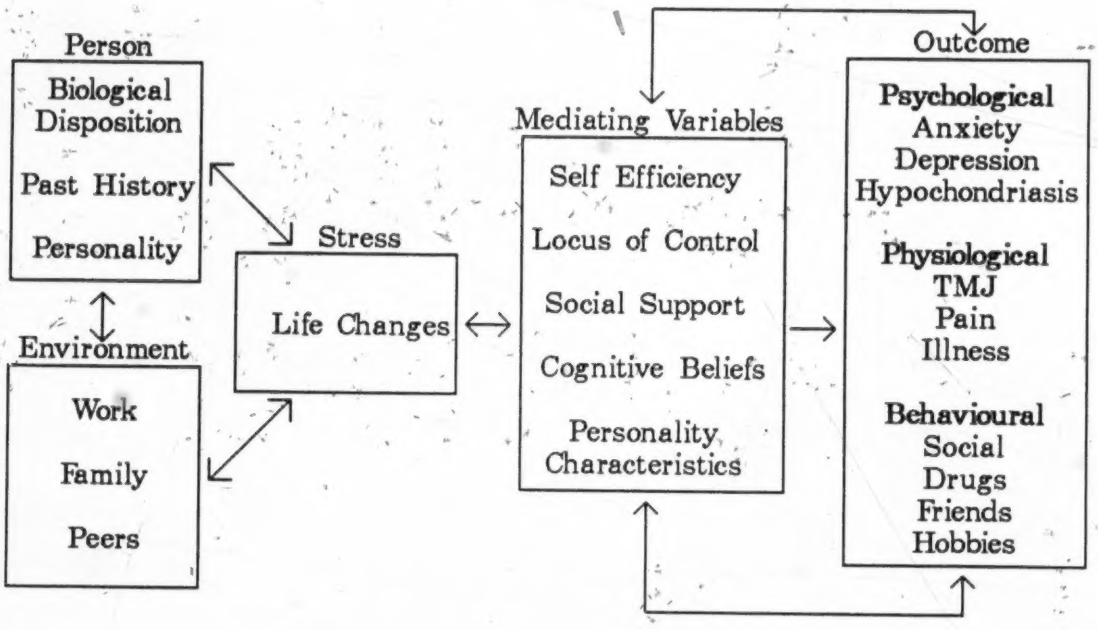
1. There is a strong link between stress, as measured by the life events and TMD (Marbach, Lennon & Dohrenwend, 1988; Speculand, Hughes & Goss, 1984).
2. Self-efficacy including high self-esteem, perceived competence in social situations, and an internal locus of control can mediate the effects of stress and illness (Bandura, 1978; Rutter, 1987).
3. Social support as measured by perceived family and friends support will protect against negative life events (Rutter, 1981, 1987).

4. Personality characteristics such as a sense of social integration, self-confidence, and a positive social orientation will act as protective mechanisms against stress and illness. While a tendency to somatize, a high anxiety level, and depressive symptomatology may render an individual at higher risk to develop TMJ (Dworkin, 1990; Fine, 1971).
5. Parafunctional habits such as grinding and clenching the jaw as a result of increased tension may precipitate and contribute to TMD symptomatology (Rugh & Harlan, 1988; Schwartz, 1955, 1956).

While there is strong evidence for these findings with adults, the research to date has not integrated these variables into a conceptual framework for adolescents. Adolescence is that period of life from puberty to young adulthood during which biological and psychological changes occur. Adolescence occurs over a well defined period of time, and adolescents share similar biological and psychosocial stresses (Kaplan & Saddock, 1985). This makes the adolescent age range a fairly homogeneous group for research purposes. The adolescent age group has not been investigated systematically with regard to TMD and psychosocial variables.

Based on previous theory and research, the following model was proposed to explain a pattern of causal relationships amongst a set of variables, as well as generate new hypotheses.

Conceptual Framework for an Integrated Model of Stress and Illness

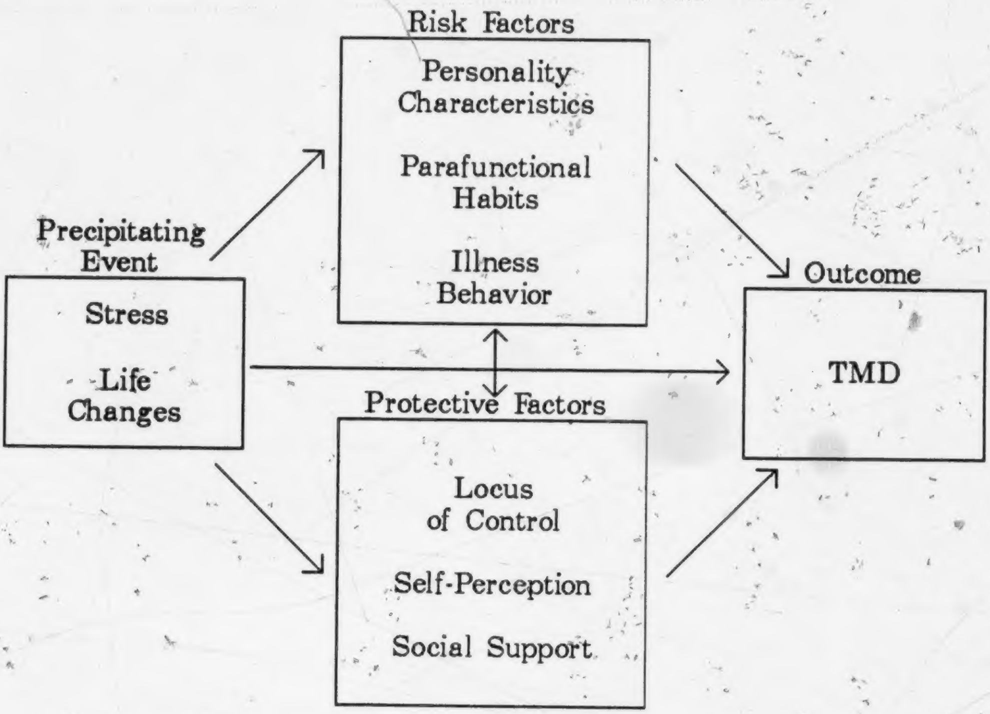

Person
Biological Disposition
Past History
Personality
Environment
Work
Family
Peers
Stress
Life Changes
Mediating Variables
Self Efficiency
Locus of Control
Social Support
Cognitive Beliefs
Personality Characteristics
Outcome
Psychological
Anxiety
Depression
Hypochondriasis
Physiological
TMJ
Pain
Illness
Behavioural
Social
Drugs
Friends
Hobbies

From the adult literature it seemed most reasonable to postulate an integrated model for stress induced illness which took into account the interaction between the individual and the environment. In this model, life stress as defined by life changes, acted on the individual and the enviroment, leading to increased adaptational skills or decompensation that may have presented itself in any combination of biological, psychological or behavioral ways. Whether or not the life changes and resultant stress brought about adaptation or decompensation depended on a number of mediating variables that came into play. These included self-esteem, belief in one's coping abilities, previous stress experiences, personality variables, and social support.

The following model was hypothesized to account for an integrated biopsychosocial model of TMD in adolesence. In this model, stress as defined by life changes interacted with the adolescent's psychological and psychosocial status, and may lead to physical changes leading to TMD. There were protective and risk factors that intervened which may have determined the severity of the resultant TMD as measured by the adolescent's scores on the Craniomandibular Index (CMI) (Fricton & Schiffman, 1986, 1987).

This model has not included issues regarding occlusion and other anatomical variables affecting the TM Joint, and which may predispose or serve as etiological factors. These factors were omitted in order to limit the focus of the study.

Hypothesized Model for Adolescents with TMD


Risk Factors
Personality Characteristics
Parafunctional Habits
Illness Behavior
Precipitating Event
Stress
Life Changes
Outcome
TMD
Protective Factors
Locus of Control
Self-Perception
Social Support

The present study attempts to test the interrelationships between the correlates of TMD in adolescents in an effort to (a) understand the psychological precursors of TMD, b) identify those individuals at risk to develop TMD, and (c) identify subgroups of TMD sufferers, and therefore, enhance treatment planning. It was intended to develop a theoretical framework for the hypothesized links between stress, mediating variables, and symptoms and signs of TMD in adolesence.

An adolescent age group was selected for this study for two major reasons. Firstly, to avoid the problems in previous research which have utilized heterogeneous groups covering broad age ranges. Although this group could not strictly be described as homogeneous, they did encompass a more restricted age range, and constituted a group with shared psychosocial and developmental problems. Adolescent growth involves considerable biological, cognitive, and emotional changes that have been theorized to differ depending on developmental level. In using an 11 to 17 year old age group, it was hoped to capture adolescents in early and middle adolescence. The assumption was that some commonality would be expected in attribution of stressful life events and other psychosocial problems in this age group (Coddington, 1972; Compas, Davis & Forsythe, 1985; Compas, Davis, Forsyth & Wagner, 1987). Secondly, in adult studies, most subjects had been suffering from TMD for many years. In that group it was often difficult to determine how much of the presenting symptomatology was related to actual TMD, and how much was secondary to the effects of chronic illness. In adult studies ,it was hard to ascertain whether symptoms such as depression, anxiety, and pain behaviors were primary precipitants of TMD or the sequela of chronic pain syndromes. By using an adolescent age group with recent onset of TMD and no previous TMD treatment, the confounding factors of chronicity seen with adults would be precluded. As already noted, part of the problem in TMD research lies in the fact that TMD may not be one condition, but rather, may consist of a number of different presentations with clinical signs varying from mild generalized headache and muscle tension, to serious occlusion and joint deterioration.

One of the major theories of TMD advocates that TMD is purely an anatomical and structural disorder with limitation of jaw movement, clicking and locking. From this perspective, the psychological symptoms and muscle tension are considered to be secondary adaptations to the TMD (Ash, 1986). An alternative approach views TMD like any other stress related disorder, where tension from the muscles of mastication would eventually lead to TMD. One of the major weaknesses in TMD research has been the lack of reliable and valid measures that can be replicated. To avoid this pitfall in the present study the Craniomandibular Index (CMI) (Fricton & Schiffman, 1986, 1987) which is an objective assessment instrument, has been used (Appendix J). Research has indicated that this is a reliable and valid measure, with clear operational definition of clinical terms, therefore avoiding many of the previously stated methodological problems (Fricton & Schiffman, 1986, 1987). By using this measure it might be possible to identify subgroups of TMD based on clinical examination, and ascertain whether the TMD spectrum does consist of a number of different syndromes.

Research Questions

The following major research questions are hypothesized in this study:

1. What are the psychosocial correlates of TMD in adolescents?
2. Is there a relationship between stress and TMD in adolescents?

3. Do mediating factors such as self-efficacy and internal locus of control play a primary role in protecting against stress and TMD?
4. Does social support mediate and act as a buffer between stress and TMD?
5. Do certain personality characteristics place an individual at risk to develop TMD?
6. Are parafunctional habits contributing factors in TMD in adolescents?
7. Is TMD a spectrum of disorders rather than one discrete disorder, and is it possible to identify subgroups of adolescent sufferers?
8. Do adolescents with TMD present with similar psychological correlates, as seen in adult patients?
9. Is it possible to identify adolescents with TMD who present with a more physical disorder from those who present with a more psychosomatic disorder based on psychological problems and TMD symptoms?
10. Is it possible to reliably measure signs and symptoms of TMD?
11. Are there gender and age differences for adolescents with TMD?

II. REVIEW OF THE RELATED LITERATURE

Epidemiology of TMD

The epidemiology of TMD is, in reality, the epidemiology of symptoms and signs related to the temporomandiblar joint and surrounding musculature. Three main groups of symptoms and signs predominate. These are (a) pain, either headache of localized, (b) TMJ noises, and (c) jaw dysfunction. Epidemiological studies have been carried out on both general population and clinic samples. For example, pain and clicking of the TM joint is quite prevalent in the general population. Salter et al (1983) reported that in a randomly selected population, 39% of adults examined had clicking, 12% complained of pain on wide opening of the jaw, and 7% had limitation of movements of the jaw. The majority of symptoms occurred in the 35 to 40 year age group, with the least symptoms in the 15 to 24 year age group. Salter et al (1983) reported on a group of 25 year olds, and found that 22% of men reported clicking of the TM joint, and 38% of the women. Five percent of men, and 11% of women had pain. However, only 2% of the men and 5% of the women had sought treatment, suggesting that something more than the symptoms alone were responsible for bringing these people for help.

The relationship of headache to TMD is uncertain, since headache is such a common complaint in the general population. Research has shown that in the general population, headaches occur in 57% to 75% of men, and 73% to 84% of women (Fricton, Kroening, Haley & Siegert, 1985). In TMD clinic populations 74% to 86% of men, and 88.6% to 90% of women had headaches. Of these 20% of women, and 9% to 16% of men had severe headaches, and 9.3% to 15.6% of men, and 9% to 15% of women had very serious headaches. Studies also reported that although headache was an important symptom in the general population, recurrent headache occurred more often in TMD patients than in the population as a whole (Magnusson, Egermark-Erikkson, & Carlsson, 1985, 1986). Studies on specific symptoms of TMD showed that it was often the pain rather than the symptoms of TM joint dysfunction, that brought an individual for treatment. Kleinknecht, Mahoney and Alexander (1987) summarized these problems and showed that the psychosocial profiles of patients in TMD clinic research studies were more characteristic of those who have pain/dysfunction symptoms.

In adult populations, although clicking and crepitus occurred in 28% to 31% of people, less than 10% had pain on muscle palpation. Only 3.5 % of the population had limitations in the range of jaw movements. Fricton, Kroening and Hathaway (1988) investigated at the prevalence of different symptoms and signs of TMD in a female general population study using a diagnostic classification based on severity. They described five progressive stages as follows: Stage 1 included cases with reciprocal clicks, no locking and maximal jaw opening of greater than 40mm. (28.1%). Stage 2 included cases with reciprocal click, history of locking closed, but no locking present on examination (2.7%). Stage 3 consisted of TMJ without reduction, maximum jaw opening of less than 35mm, a history of clicking and lateral deviation with full opening (0.8%). Stage 4 was also without reduction, but with jaw opening of 35mm to 42mm only with clinical assistance, pain on jaw movement, reproducible clicking on opening and closing the jaw, and some crepitations (0.4%). Stage 5, there was maximal opening less than 38mm and crepitations(3.1%). These researchers also pointed out that while symptoms might present in the general population at all levels of severity, attendance at a clinic for treatment probably depended on other factors, such as degree of pain, functional disturbance, social modelling, and availability of treatment resources. Estimates of need for treatment in the population presenting with TMD signs and symptoms vary between 5% and 15% (Fricton & Schiffman, 1987; Solberg, Woo, & Houston, 1979). No general population studies of the progressive nature of TMD appear in the literature.

TMD in Children and Adolescents

There had been relatively little research into TMD in children and adolescents. The literature surveyed indicated that 5% to 15% of children aged 11 years would have symptoms or signs of TMD, of which 1% would require treatment (Rugh & Solberg, 1976). Fifteen to 23% of children in the general population reported recurring headaches (Fricton et al, 1985) without TMD. Given & Stack (1986) also reported that the incidence of TMD in adolescents was similar to adults. Nilner (1981, 1983a) examined a random sample of children and adults, and found that 36% of children, and 41% of adults reported one or more symptoms of TMD.

Belfer and Kaban (1982) carried out a prospective study of 400 patients with TMD over a four year period.

Ten percent (n = 40) of the patients in their sample were children aged 10 to 16 years. Primary psychological factors were found in 25% of the children who were all diagnosed as having reactive depressions. These researchers suggested that the psychological symptoms were "depressive equivalents" or "masked depressions". In a study of elementary students who attended special education classes for either remediation or enrichment, it was found that in the remedial group there was a much higher incidence of malocclusion, general health problems, and psychological difficulties. Twenty-five percent of children with TMD were shown to have anxiety, depression, school related difficulties, or the presence of psychiatric illness in the family (Belfer and Kaban, 1982).

Alternatively, in the dental literature, Pillermer, Masek and Kaban (1987) suggested that maladaptive oral habits including pencil chewing, nail biting, bruxism, were related to TMJ muscle and joint pain. They also postulated that malocclusion was a contributing factor in precipitating TMD symptoms. To date there has been strong evidence to support the role of emotional stress in this symptom in adult studies (Rugh & Lemke, 1984).

The etiology of bruxism in children is unclear. Research indicated that 12% to 15% of children 3 to 12 years of age ground their teeth. Clenching was the most frequently found oral habit, and occured in 50% to 68% of adolescents with TMD (Gelb & Bernstein, 1983; Wanman & Agerberg, 1986a, 1986b). Nilner (1983b), in a random sample of 440 school children, found a significant correlation between nail biting, lip/cheek biting, and teeth clenching. It is not yet clear whether parafunctional habits are associated with TMD in children.

Vanderas (1988) suggested that since TMD was multifactorial, it was necessary to investigate a number of factors to determine the potential etiology. These included malocclusion and oral parafunctional habits, dentofacial injuries, orthodontic treatments, and emotional status. He studied 386 children aged 6 to 10 years, who presented for routine check-up, dental treatment, or orthodontic evaluation. Assessment utilized subjective symptom reports and objective clinical evaluation. Parents were also asked to evaluate the psychological qualities of their children under five headings: (1) calm, (2) tense, (3) anxious, (4) nervous, and (5) under stress. In those children classified as tense, anxious, or under stress, parents were asked to provide actual life events that might have caused their condition. The results showed a significant difference between those children categorized as calm, and those rated as tense, anxious, or under stress, with respect to muscle pain and TMJ tenderness. Based on this study, Vanderas advocated an interactional model to examine the functional, structural, and psychological factors that might lead to TMD in children. He developed a host-agent model to describe the interactional variables. The host is the individual at risk, while the agent is the precipitant of pathology, and included environmental factors as well as interpersonal and psychological factors, physical health, and parafunctional habits. The eventual outcome, in this case the TMD syndrome, was a possible result of the influence of the agent on the host. However, the results of Vanderas' (1988) retrospective study must be treated with some caution, since the report was based on subjective opinions of parents only, and no objective indicators of emotional state were used.

Bernal and Tsamtsouris (1986) conducted a study of 149 children aged 3 to 5 years attending a Head Start Program. TMD symptoms were reported in 38% of children, most of whom had earaches and bruxism. Of these, 5% had clicking, 5% had tenderness on palpation, 20% had irregular movement of the condyles, 9% had jaw deviation from the mid-line, and 9% had cross-bites. In a review of TMD symptoms and signs in adolescents, Wigdorowicz-Makowerowa (1979) studied over 2,000 subjects aged 10 to 15 years. The study showed that TMJ sounds occurred in 26.6% of their sample.

Given and Stack (1986) suggested that TMD was a chronic problem which began in childhood with headaches, concentration problems, earaches, and tinnitus. They postulated that the syndrome progressed over the years, so that by the teen years, popping or clicking of the joints occurred, and headaches worsened. Belfer and Kaban (1982) conducted clinical and psychiatric examinations of 40 child patients from 10 to 16 years of age, who presented with TMD and facial pain. In their sample there ~~were~~ 28 girls and 22 boys. Fourteen patients (35%) were diagnosed with reactive depressions. They suggested that in these cases, the TMD was a depressive equivalent. They also suggested that TMD should be suspected in children with recurrent facial pain or earache when no other cause was found, and that it must be differentiated from repeated otitis media, especially when there is no infection. It was found that the incidence of TMD in children was the same as in adults (Egermark-Eriksson, Carlsson & Ingerval, 1981; Egermark-Erickson, Carlsson & Magnusson , 1987).

Nilner (1983), in a large random sample found that 36% of children, and 41% of adults reported one or more TMD symptoms. Gelb and Bernstein (1983) found 94% of children referred to them by dentists because of facial pain, had muscle spasms of the face and neck, 88% had TMJ pain, and 50% were bruxers. In a cross-sectional study of 1,342 child subjects aged 6 to 17 years, Riolo, Brandt and TenHave (1987) examined the prevalence of subjective symptoms and clinical signs of TMD and their association with occlusion. They found that temporomandibular joint pain, muscle tenderness, and restricted jaw opening were associated with open bite, functional shift of the jaw, excessive or negative overjets, and jaw noises.

Wanman and Agerberg (1986d, 1986e) examined the prevalence of symptoms and signs of TMD in adolescents on a longitudinal basis. They pointed out that TMD symptoms were much more common in this age group than previously thought. They studied 285 teenagers in a Swedish town who had been receiving regular dental check-ups at the same clinic since aged 6. These researchers devised a questionnaire to inquire about health status and the presence and type of headaches, jaw dysfunction, oral parafunctional problems, and any trauma to the jaw. They also used the Helkimo Amnestic Dysfunction Index, a self adminstered questionnaire to determine the symptoms, including location, frequency, and severity, as well as the patient's assessment of need for treatment. They found that only 5% of their sample had other health problems, whereas 20% of adolescents had symptoms of TMD dysfunction. Thirteen percent were classified as mild, whereas 7% had severe symptoms. Headaches appeared on a recurrent basis in 12% of cases and were more often present in girls. They also found that school work was affected by symptoms. Sixty-eight percent of the sample had some parafunctional problems. The most common sign of TMD disturbance in this group was tenderness on palpitation of the muscles of mastication and were more significant in girls than boys. They examined 258 children from this sample group two years later and noted that in the symptomatic group problems had worsened with age, especially in girls. Girls also reported stress-related clenching or teeth grinding. These authors commented on the need for routine screening of the adolescent population for TM disorder. They pointed out that symptoms tended to be mild and fluctuate in the majority of cases, and that longitudinal studies need to be carried out for longer periods to establish the progression of the problem into adulthood.

Further research by Egermark-Eriksson et al (1987) involved a longitudinal study of 240 children examined at age 7, 11, and 15 years. The study attempted to look at the relationship between mandibular dysfunction, occlusal problems, psychological traits, and motor activity on five point scales. Consistency over time was found in the prevalence of occlusal problems, but no psychological changes were apparent. These authors also noted the persistence of mild TMD symptoms which did not worsen over time. They suggested that their results pointed to the probability of TMD having a multifactorial basis.

Summary

Problems abound in attempts to make sense of the wide range of findings in TMD research because of the differences in methodology, and lack of clear cut clinical criteria and measures used to evaluate TMD symptomatology. Often heterogeneous groups were used with poor control of variables, casting doubt on the internal and external validity. In general, epidemiological studies suggested that TMD was a very complex, multifactorial disorder which occured in children and adults. It was apparent that TMD symptomatology was more prevalent in childhood and adolescence than generally realized, and that the dysfunction may have become chronic by the time the individual reached adulthood and perhaps sought treatment. This makes early recognition and treatment important. The majority of studies with children suggested that TMD symptoms, although showing some evidence of gradually worsening over time, may not have been sufficent cause for the individual to seek treatment. This indicated that there may indeed have been other factors which differentiated those who sought treatment from those who did not.

Historical Overview of TMD

Symptoms suggestive of TMD were reported by Hippocrates as early as the 5th century B.C.. Hippcorates described "...groups of patients whose teeth are disposed irregularly, crowding one on the other and they are molested by headache and otorrhea" (Speculand, Goss, Hughes, Spence & Pilowsky, 1983, p. 139). The modern revival of TMD was attributed to

Costen, a physician, who specialized in ear, nose, and throat disorders. In 1934 Costen described a syndrome in 11 patients who presented with a number of symptoms and signs including dizziness, tinnitus, headaches, and difficulty with hearing. These patients also had burning sensations in the mouth and tongue, earache, and clicking of the temporomandibular joint. Costen focused on the symptoms involving the ear and sinuses, and felt that a disruption in the occlusal forces produced pressure on the nerves leading to the ear, and in turn produced pain and clicking (Eversole & Machado, 1985).

Costen's Syndrome was the term used to describe the condition which encompassed a great number of symptoms related to the head, neck, and jaw. Associated with this was functional and structural change of the muscles of mastication, limitations in movement of the jaw, and joint sounds that included clicking, popping, and crepitus. Costen's Syndrome also covered a disparate series of symptoms including facial, head, and neck pain, stuffiness, headaches, and impaired hearing, all no longer considered central to the TMD Syndrome (Duinkerke, Luteijn, Bouman & deJong, 1985).

In the 1950's there was a renewed interest in the syndrome and many of Costen's original findings were discounted, especially the general symptoms not directly concerned with structure and function of the temporomandibular joint. Schwartz (1956) first used the term Temporomandibular Joint Pain-Dysfunction Syndrome, to describe the condition. Schwartz drew attention to psychosomatic factors as precipitants of the condition. In particular, he focused on the role of stress and tension. In the 1960s, the classification of TMJ disorder was broadened to include bruxism as an etiologically significant factor, and the probable starting point for the disorder (Gelb, Calderone, Gross & Kantor, 1967). It was suggested that teeth grinding led to muscle spasm, which in turn caused muscle imbalance, with facial pain, and limitations in jaw movement. This view was also shared by other researchers (Weinberg, 1987).

Laskin, in 1969 refined the psycho-physiological model proposed by Schwartz and introduced the term Myofacial Pain Dysfunction Syndrome (MPDS). In this model, chronic life stress induced muscle hyperactivity and hypertonicity, especially in the muscles of mastication. Over time this led to joint disruption and displacement, and eventual arthritic deterioration

(Laskin, 1969). Other researchers in the 1960s and 1970s also focused on stress, psychosomatic, and psychogenic etiologies. Attempts were made to link TMD to personality type, emotional states including early childhood trauma, and actual psychiatric conditions (Fine, 1971).

Over the years there has been much continued discussion and disagreement as to what constituted TMD. Many researchers included a very broad range of symptoms varying from general facial and head pain, with or without joint involvement, to localized problems in the temporomandibular joint including joint degeneration and arthritic changes. There is still no consensus regarding a central syndrome or etiology. It has been suggested that it would make more sense to divide the syndrome into two categories: (1) myofacial pain and (2) temporomandibular joint derangements (Eversole & Machado, 1985).

In the present study, the term temporomandibular disorder (TMD) is used to encompass all conditions sharing symptoms and signs involving the temporomandibular joint and associated musculature. This term will include myofacial pain disorders and problems with internal joint derangement.

Structure and Function of Temporomandibular Mechanisms

A review of the structure and function of the stomatognathic system that incorporates the jaw and facial bones, muscles, teeth, ligaments, nerves, and blood supply will help with the understanding of Temporomandibular Dysfunction (TMD). This extremely complex, interactive system co-ordinates such functions as speech, eating, and swallowing. This research does not focus on anatomical and physiological variables, and therefore only a brief review of the temporomandibular mechanism is presented.

Components

The three osseous components of the masticatory system are the (a) maxilla, the (b) mandible, and the (c) temporal bone. The temporomandibular joint is the articulation between the mandible and temporal bones. These two bones are separated by an avascular cartilaginous disc and allows the articular surfaces of the mandible to undertake complex movements. The joint is encapsulated by a fibrous ligament that contains the lubricating and nutrient synovial fluid.

It is possible for the tempormandibular joint to make hinging and sliding movements either separately or together. The tempormandibular joint is a compound joint consisting of a superior and inferior joint compartment. Each joint can act separately or compliment each other enabling very complex movements to occur. The inferior joint compartment consists of the condyle and the articular disc, while the superior joint compartment consists of the condylar disc complex and the fossa\eminence complex (Clark, 1987; Dunn & Schulze, 1989).

The bones that make up the temporomandibular joint are supported by ligaments and muscles. There are three main ligaments for each joint. The ligaments consist of fibrous tissue and limit the range of movements of the joint. These are (a) the collateral ligament, (b) the capsular ligament, and (c) the temporomandibular ligament. There are also two accessory ligaments which help to support the joint, the sphenomandibular ligament and the stylomandibular ligament. The names of the ligaments indicate their bony attachments. The various ligaments have both vascular and nervous supplies. The nerve connections are sensory and provide the brain with information as to the joint's movements and position, and when strained, produce pain (Dunn & Schulze, 1989).

The movements of the temporomandibular joint are made possible by the muscles of mastication which are as follows.

1. The masseter is a large rectangular muscle that originates at the zygomatic arch and inserts in the lateral part of the mandible. As the masseter muscle contracts it moves the mandible superior and anteriorly.
2. The temporalis is a large fan shaped muscle which is attached to the side of the skull and extends to the anterior part of the mandible. This muscle has anterior, middle, and posterior portions. Contraction of the temporalis muscle assists in the superior movement of the mandibular ramus. The various parts can, however, contract separately so that contraction of the anterior and middle portion make the mandible move vertically upwards, while contraction of the posterior portion elevates and retrudes the mandible.
3. The medial pterygoid muscle originates from the medial aspect of the pterygoid plate of the sphenoid bone and extends to the medial surface

of the ramus of the mandible. It acts to bring the teeth together and assists the mandible to protrude.

4. The lateral pterygoid muscle is divided into an inferior and lateral part which assist in lateral movements of the jaw (Juniper, 1987; Rayne, 1987). The inferior lateral pterygoid muscle is assisted in opening the jaw by the mylohyoid, stylohoid, digastric, and geniogyoid muscles. These come into play at the beginning of mouth opening. The digastric muscle consists of two parts: the (1) posterior, arising from the mastoid notch of the temporal bone passing anteriorly and inferiorly; and the (2) anterior portion of the digastric muscle, beginning in a depression on the inner surface of the inferior mandibular border which runs posteriorly and inferiorly. The two portions end in a tendon which perforates the styloid muscle, and is connected to the hyoid bone by fibrous tissue. The digastric muscle helps in opening the jaw by raising the hyoid bone, (Mahan, 1980).

Neuromuscular System

The nervous supply to the muscles of mastication consists of sensory and motor nerves. The sensory nerves carry information from the muscle to the central nervous system via the spinal cord. Propioceptors provide information about the position of the mandible in space, while nociceptors relay information about pain and fatigue, as well as damage. Once the sensory information has been received in the brain it is processed and appropriate information is returned via the efferent, or motor nerve fibers to make the muscles respond correctly. At the central level the control of the mastication apparatus is at the cortical level. However, input also occurs from the reticular system which modifies motor neuron activity. The limbic system is associated with emotional reactions, and the hypothalamus co-ordinates many motor functions via the autonomic nervous system. The latter two systems are particularly important in co-ordinating motor functions with emotions and behavior, and are particularly important to the psychophysiological aspects of TMD (Fricton, Kroening & Hathaway, 1988).

Dysfunction of the Temporomandibular System

A number of different problems can affect the temporomandibular joint. They may be considered under three main headings: (a) disorder of the muscles of mastication, (b) internal joint derangement, and (c) joint degeneration.

Myofacial Pain Dysfunction (MPD)

These conditions are characterized by headaches, masticatory muscle pain, and pain and tenderness in the different muscles of the head and neck. It has been subdivided into three categories, (a) myalgia, which is the term used to describe pain sensations and muscle tenderness, (b) trismus, also called splinting refers to a decrease in the pain free range of motions of the jaw. It is generally invoked because of the underlying pathology, and serves to protect the damaged tissue, and (c) mandibular discordination which includes a decrease in smoothness of jaw movement, lack of co-ordination of lateral, protrusive or opening movements, or decreased proprioceptive ability (Bell, 1985).

Internal Derangement

This condition is characterized by alteration in the intracapsular components, or mechanical problems that interfere with normal joint action. There is an abnormal relationship between the disc and the condyle, generally with anterior displacement of the disc, with or without reduction. In cases of anterior disc displacement, patients complain of pain and limitation in jaw opening with or without a history of clicking. The pain may persist after the clicking disappears. There may be restricted jaw opening and pain on maximal opening.

The symptoms associated with internal joint derangement include clicking and crepitus. Clicking has been reported in 28% to 32% of TMD patients and may occur on opening or closing the jaw. This may lead to deterioration and perforation of the disc. Medial disc displacement may also occur, but is less commmon (Moss & Garrett, 1984).

In order to understand the production of these sounds, it is necessary to review the function of the TM joint. As the jaw opens the head of the mandible rotates forward on the bottom surface of the articular disc. Two muscles make this possible, the (a) inferior lateral pterygoid which opens the mouth, and the (b) superior pterygoid which assist in stabilizing the condyle during closing movement. These muscles are attached to the joint disc and act so that the disc and the condylar head of the mandible are both able to move synergistically to bring about smooth jaw movement. When the jaw is closed the condyle and the capsule return to the resting position. In TMD there may be dislocation of the disc because of stretching or tearing of the disc attacment so that the disc does not slip back into place, and remains anteriorly dislocated. It may be possible to reduce the dislocation by manual manipulation, but in chronic cases reduction is usually not possible (Clark, 1987).

Posterior capsulitis is a term used to define a condition in which there is inflamation of the posterior part of the joint capsule caused by infection or trauma, and may result in the mandible being postured forward. Attempts to close the jaw result in pressure on inflamed tissue, leading to pain and muscle spasm. Diagnosis may be confirmed by forced jaw opening, which causes deviation to the affected side on jaw opening, with deviation to the other side on jaw closure. Radiographic findings may show the forward dislocation of the condyle (Bell, 1985). Ear pain and tinnitus may be associated with posterior capsulitis possibily as a result of referred pain or deformation of the anterior malleolar ligament which brings about increased middle ear pressure (Clark, 1987).

Degenerative Joint Disease

This is the term used to describe osteoarthritic changes in the TM joint and may represent the terminal stage of TMD through destruction of the articular tissue and bone. The tempormandibular joint may undergo remodeling to accommodate altered function. If functional demands exceed the adaptive capacity, breakdown or joint disease may occur in the cartilaginous articulating surfaces of the joint leading to non-inflammatory breakdown. Pain may be present on jaw movement and persist throughout the day. In patients with degenerative joint disease there may be pain on movement or biting, reduction of joint movement, tenderness on palpation of the joint, and crepitis. The diagnosis of degenerative joing disease is made from diagnostic imaging. Clinically TMD may begin with internal derangement and progress to degenerative joint disease. Degenerative joint disease tends to run a progressive course of one to three years followed by a natural regression of symptoms with little or no permanent disability, even though joint crepitus may persist (Clark, 1987).

Eversole and Machado (1985) proposed a classification scheme to explain the natural progression of TMD. They divided TMD into five stages which may overlap.

Stage 1 refers to myogenic facial pain. Joint sounds are usually absent and limitation of jaw movement is the result of muscle spasm.

Stage 2 the patient may have internal derangement with an opening click, with or without a closing click.

Stage 3, internal derangement includes locking and clicking. Muscle tenderness may also be present.

Stage 4 with internal derangement there is a closing lock, restricted jaw opening, and painless crepitus.

Stage 5 is the final stage when there is degenerative joint disease. The pain may be considerably reduced. The total time taken to encompass all the stages has been described as being as little as 18 months, or as long as 5 years (Eversole & Machado, 1985; Rasmussen, 1981).

Differential Diagnosis

The differential diagnosis of TMD includes inflamation due to local trauma to the joint internal derangement, myospasm, inflammmation of the joint because of arthritic conditions, localized infection to the joint and problems in associated structures including teeth and aural apparatus. Conditions which affect the salivary glands, cervical disc disorders, sinusitis, posture, and neuralgias also need to be considered. Differential diagnosis must also include more general conditions such as neoplasia, rheumatoid arthritis, metabolic disorders, and neuromuscular disorders (Ash, 1986; Clark, 1987; Moss & Garrett, 1984).

The Relationship of TMD to Psychological and Psychosocial Functioning

Psychodynamic Theories

The earliest speculations as to the psychological basis of TMD followed the teaching of the psychoanalytic schools and early theories of psychosomatic medicine. These views suggested that pain and. other psychosomatic manifestations could be the result of early childhood trauma and repressed emotions, with displacement on to particular organ systems. From this theoretical perceptive, TMD was seen as a "conversion reaction" (Engel, 1951). Engel hypothesized that oral systems were associated with guilt around sexual issues, following Dunbar's assertion that the teeth are symbolic of the genitals. The pain associated with TMD was then considered a re-creation of pain experienced in infancy, associated with intense emotional feelings, particularly anger, which had been repressed (Pugh & Solberg, 1976). Lefer (1966), a dentist and psychoanalyst, postulated that TMD was related to early loss experiences. This led to separation anxiety which was manifested in teeth grinding and eventual development of TMD. He viewed TMD as a response to problems in early oral gratification.

The mouth, in psychoanalytic terms is seen as a source of gratification for the baby through feeding. The mouth is also the region through which the young child expresses frustration and disappointment, through crying and screaming. In TMD patients a loss or disappointment in adulthood brought about a regression to infantile ways of expressing frustration. Clenching and grinding were viewed as the analogue of the infantile rage responses, with the oral cavity again being the source of gratification and a vehicle through which to express rage and frustration. However, it has been suggested that classical psychoanalytic theories of TMD are based on theoretical positions that could not be verified and that psychoanalysis had little to offer with respect to possible etiological significance or treatment (Rugh & Solberg, 1976).

Personality Theories

Further studies attempted to link TMD to a particular personality profile using standardized psychological tests including the Minnesota Multiphasic Personality Inventory (MMPI), and various Depression and Anxiety scales. This approach also stemmed from psychosomatic theories which suggested that particular illness presentations were related to personality profiles, that might in turn predispose the individual to develop a particular symptom complex or syndrome. Moulton (1955) speculated that TMD occurred in individuals, particularly females, who were high strung, dependant personalities and who had associated depression and anxiety. She suggested that TMD pain was similar to functional back pain, and that individuals with TMD relieved their tension by teeth grinding, eventually leading to muscle spasm and joint derangement. She also demonstrated that the topical application of a anaesthetic, ethyl chloride, over the effected muscle groups relieved both conditions. However, present knowledge of physiological pain processes provide sound explanations of how localized applications of heat and other agents might relieve pain, regardless of cause, and negates Moulton's conclusions.

Moss and Adams (1984a) carried out a study on TMD clinic patients using the MMPI, Spielberger's State-Trait Anxiety Inventory, and the Beck Depression and Hopelessness Survey. They used one experimental and two control groups of subjects presenting with TMD and facial pain. One control group had TMJ sounds without pain, and the other control group was asymptomatic. Their research did not confirm any specific personality profile which would differentiate the pain group from the other two groups. They did, however, point to an important limitation in their study, in that, none of the patients experienced pain during the time of the testing. They suggested that the significant personality variables reported in other studies might be secondary to the experience of chronic pain, rather than TMD itself. Eversole and Machado (1985) in a further study, divided their subjects into three groups based on clinical features. These were (a) myogenic facial pain, (b) TMJ internal derangement, and (c) atypical facial pain. These researchers found that in the myofacial pain and atypical facial pain groups there were elevated scores on MMPI scales that reflected hypochondriasis, depression, and hysteria. They suggested that these two groups differed psychometrically from the internal derangement group, even though physical clinical findings in all three groups were similar. This may explain the discrepancies between the various studies on personality variables and TMD which usually involved heterogeneous diagnostic groups. This research also has treatment implications since the patients in whom pain is predominant may respond to psychological and psychiatric treatments including medications, and patients with physical signs of derangement alone may benefit from conservative dental management.

Duinkerke et al (1985) examined 211 patients with TMD using the Hopkins Symptom Check List, a measure of psychological status. They utilized two patient checklists to measure clinical symptoms related to TMD including (a) chewing problems, (b) headaches, (c) neck pain, (d) shoulder pain, and (e) TM joint pain. The second checklist included six symptoms of (a) teeth clenching and grinding, (b) popping and clicking, (c) stiffness of cheek muscles on awakening, (d) limited mouth opening on awakening, (e) pain during chewing, and (f) chewing on one side. They measured maximal mouth opening and tenderness to palpation as well as the Psych and Somat scores of the Hopkins Symptom Checklist, that measure respectively psychic and somatic well-being based on patient responses. They found that the signs and symptoms of TMD were significantly correlated to the two Hopkins scales except for maximal mouth opening, and that the palpation score on the dental indices was a good way of determining the severity of the TMD.

Speculand and Goss (1985) concluded that although specific personality variables could not be found in TMD patients, multiple psychological variables could be involved. Speculand and Goss divided these variables into two groups: (a) external social factors and (b) the psychiatric state of the patient. They concluded that life events may be relevent in explaning why an individual seeks treatment for TMD, especially severe events such as death of a family member. They commented than the individuals response to life events depended on their psychological stability. Psychologically unstable patients might have had a poor response to conservative treatments.

Salter et al (1983) conducted a prospective study to look at the relationship between TMD, psychological variables, and outcome. The instruments used were the General Health Questionnaire, the Crown Crisp Experiential Index (a questionnaire which measures anxiety, depression, and tendency for somatization), and the Parental Bonding Instrument which measures people's perception of early child experience. This study found that patient outcome was not significantly correlated with severity or the duration of presenting symptoms, but was related to psychological distress. A conservative treatment approach was used over three months, at which time patients were reassessed. Those patients having mild psychological symptoms did well with treatment, while those with severe psychological symptoms did poorly. This research indicated that although psychological factors might not be directly related to incidence of TMD, they were related to treatment outcome.

Emotional Dysfunction

Fine (1971) reported that at clinical interview, 76% of TMD patients had psychiatric problems compared to 20% of controls. Fine believed that patients with atypical facial pain and non-organic TMJ probably had a psychiatric illness and would respond to psychiatric treatment. Marbach and Lund (1981) measured the presence of depression, anxiety, and self-reported pain in a sample of 476 pain patients. They divided their study sample into three facial pain groups and three control groups. The three facial pain groups consisted of (a) those with myofacial pain dysfunction syndrome (MPDS), (b) those with arthritis of the temporomandibular joints and (c) those with trigeminal neuralgia. They also used three control groups; (a) patients with general arthritis, (b) patients with movement disorders attending a neurology clinic, and (c) a normal control group. Their results indicated that the patients with facial pain were not different than the normal control group in either depression or anxiety. The subjects with trigeminal neuralgia reported most pain. MPD subjects had more pain than arthritic controls, but were similar to subjects with arthritis of the TM Joint. Depression was found to show some association with duration of pain, number of previous consultations, and total number of symptoms. A similar finding was reported by Gale and Funch (1984), who found that in TMD patients psychosocial factors were better predictors of outcome than clinical presentation. In particular, patients with most motivation had an internal locus of control, were least depressed, and had a more successful outcome with behavioral treatment.

Greene, Olson and Laskin (1982) reviewed the relationship of stress, anxiety, and depression in TMD. They summarized their research by stating that TMD patients with pain are more anxious than those without pain. They suggested that a proper treatment procedure could be arrived at only by large prospective studies looking at premorbid and post-illness anxiety. They concluded that the mild increase in depression scores found in many studies of TMD patients was related to concern about being ill rather than by the illness itself. Stress has also been associated with TMD, but these researchers have pointed out that "...a clinical finding of psychological stress in the life of one individual cannot be definitely correlated with the etiology of his or her MPD symptoms, any more than various physical abnormalities can" (Greene et al, 1982, p. 445).

Somatization

Somatization refers to the tendency of some individuals to use somatic complaints to reflect life problems (Escobar, Burnam, Karno, Forsythe & Golding, 1987). Lipowski (1988) summarized the present state of information regarding somatization. He pointed out that medical practitioners have been aware of the problem for centuries, using such terms as hysteria, melancholia, and hypochondriasis. All these terms have now been subsumed under the term "somatoform disorders" in the current Diagnostic and Statistical Manual of Mental Disorders, of the American Psychiatric Association (DSM III-R 1987).

Lipowski (1988) reported that the term "somatization" was first used by Stekel in the 1900s and that a current definition for somatization is "...a tendency to experience and communicate somatic distress and symptoms unaccounted for by pathological findings, to attribute them to physical illness and to seek medical help for them" (p. 1359). Somatization is not always a psychological or psychiatric problem, but is an acceptable way of describing emotional distress in many cultures. For example, phrases such as "to have a heartache", or being "sick to the stomach", are common in our language to describe affective states. However, somatization does become problematic when it leads to repeated use of health care resources and a reluctance to accept medical reassurances that there are no physical pathological processes evident. Lipowski (1988) reported that 5.2% of 260,000 patients in an American hospital study were somatizers. The most common complaints included (a) abdominal and chest pain, (b) difficulty breathing, (c) headache, (d) fatigue, (e) back pain, and (f) dizziness. Of these patients 30% were shown to have psychiatric disturbance.

From a clinical perspective somatizing patients often have multiple physical symptoms. The most usual symptom is pain, often in the back, head, abdomen, and pelvis, as well as muscle aches. Some patients may also show conversion reactions, in that they lose some aspect of bodily function. Others complain of multiple allergies. Somatization can become delusional and can be part of depressive or schizophrenic psychosis. It should be cautioned, however, that somatization may co-exist with a medical illness, or be a sign of a disease process such as multiple sclerosis, which is initially, not diagnosed.

Somatization disorders may have a multifactorial etiology. Lipowski (1988) suggested a classification of causative factors into three major groups: (1) predisposing factors, (2) precipitating factors, and (3) maintaining factors. Predisposing factors included genetic, developmental, personality, and socio-cultural variables. Family factors are also important since particular families may respond to emotional distress only when expressed in a physical way. The child often learns to demand attention and to communicate with somatic complaints, a tendency which becomes learned and often life-long (deLeon, Saiz-Ruiz, Chinchilla & Morales, 1987). From a cultural perspective somatization is more common in cultures in which emotional expression of distress is discouraged. It is also more prevalent in lower socio-economic groups.

Preciptating factors also incorporate life stress, such as problems in relationships, bereavement, injury, and illness. Maintenance factors in somatization are those situations which contribute to the persistence of symptoms and include the families, physicians, and society's response to the symptoms. Individuals may develop a "sick role" to cope with neurotic issues, problems in self-esteem, guilt, self-consciousness, and difficulty coping with life problems. In general, somatization can then be considered to be "...a common, if maladaptive and largely unconscious motivated coping strategy to deal with life demands and frustrations" (Lipowski, 1988, p. 1366).

Dworkin, Von Korff and LeResche (1990) suggested that pain may represent a non-specific symptom of depression, but that in these cases the pain is often multiple and not localized to a particular organ or body part.

Learned Behavior

A further theory of etiology of TMD concerns the concepts of pain and illness behavior. This approach is based on an analysis of socio-cultural, personal, and environmental influences, and the way in which pain or illness is perceived or evaluated. Some individuals have been shown to react more severely to illness than others, which affected both treatment and outcome. The characteristics of abnormal illness behavior can be elicited during an initial interview, and include a phobic concern about health, and a conviction in the indidividual that they are ill, even in the absence of medical confirmation. Studies have shown that such individuals preferred a somatic, rather than psychological view of illness. They often had an inability to express negative feelings to others and had difficulty acknowledging anxiety or depression and the presence of life problems (Speculand et al, 1983). Individuals with abnormal illness behavior often come from families where physical expression of illness resulted in increased attention, or where the expression of physical symptoms led to "secondary gain", which included attention or escape from unpleasant situations, either at work or home. In this context, chronic pain was viewed as a learned behavior which involved operant conditioning of responses. (Fordyce, Lansky, Calsyn, Shelton, Stolov & Rock, 1984)

Speculand et al (1983) studied illness behavior in 100 subjects with TMD and 100 asymptomatic patients. They used an illness behavior questionnaire and demonstrated that compared to controls, patients with TMD had a greater illness conviction, were significantly more anxious or depressed, and were more likely to deny life problems. Overall in that study, 29% of the TMD patients had abnormal illness behavior compared to 19% of the controls. Fifty percent of patients who did not respond to conservative treatment showed abnormal illness behavior and showed more psychiatric impairment. In summary, these researchers found that TMD patients were more convinced that they had organic disease and showed higher scores for anxiety and depression. They concluded that TMJ patients were more hypochondriacal and had a greater reluctance to accept non-physical explanations for their pain (Speculand et al, 1983).

Heloe, Heloe and Heiberg (1977) studied the relationships between socio-medical factors and Myofascial Pain Dysfunction (MPD). The majority of their cases were young and middle aged women. These MPD sufferers had a number of life stressors, most prominent of which were work related anxiety, and frustration due to disease, and family problems. Seventy-eight percent of the patients were in pain, 53% had clicking, 44% had limitations of movement, and 41% had stiffness and tiredness of the masticatory muscles. They found that there was a strong correlation between stressful events and the number of muscles that were painful. The patient population was in good health and suffered little somatic disease, but despite this, judged their lives to be stressful.

Marbach, Lennon and Dohrenwend (1988) conducted a retrospective study of patients with TMD and reviewed potential risk factors. They believed the results of earlier studies that suggested a psychological basis for TMD had not been well validated, and that TMD patients did not differ in levels of depression, social dysfunction, of abnormal illness behavior. They pointed out that there was a small, but significant correlation with locus of control and denial of psychological problems. These researchers suggested that although TMD patients might relate the onset of pain to recent stressful life events, insufficient attention had been paid to other factors affecting perceived stress, such as social support systems, the influence of chronic illness, and health behavior. For example, drug use amongst chronic pain patients which included narcotic and/or sedative drugs was approximately 70%. Thirty percent to 50% of chronic pain sufferers were addicted to their medications. Yet, these researchers commented that the level of physical health which might effect the psychosocial status in TMD patients has not been addressed. A number of scales were used to measure (a) recent stressful life events, (b) personality characteristics, (c) domestic support, (d) health behavior and physical health, (e) substance use, (f) reproductive health, (g) physical injury, and (h) illness. Their results indicated that in TMD cases there was a higher level of distress and recent life changes, especially associated with other physical illnesses. There were no differences in personality measures between controls and TMD patients, although the TMD sufferers showed a higher level of concern about health, illness, and dying. TMD sufferers showed no differences in social arrangements, except that emotional support was perceived to be less in the TMD groups. There were no differences in health behaviors or physical health. More TMD sufferers were found to have used drugs to control pain. Interestingly, reproductive status differed between controls and TMJ groups, with TMD sufferers less likely to have children. Finally, TMD patients reported more other chronic illnesses. Marbach et al suggested that TMD patients had experienced more health problems, but also they had a higher vulnerability to other illnesses and injuries. Alternatively, these authors postulated that it may be that the pain experience was debilitating and increased vulnerability to accidents or illness. They stated that "...TMPDS patients are abnormally distressed individuals who are beleaguered by recent physical illness and injuries as well as pain, who tend to attribute their fate to external factors and who have fewer of some important types of social support" (Marbach et al, 1988, p. 150).

In summary it appears evident that uni-causal theories of the etiology of TMD have been found wanting. This may relate to the heterogeneity of the condition and the fact that different studies were dealing with different portions of a heterogeneous patient group. It has, however, been established that TMD symptoms exist widely in the population and that something more than the TMD itself is necessary to bring the individual to treatment. It is also known that the TMD patient shares many, although not all, features of the chronic pain patient. Some TMD patients, particularly those who did not respond to conservative treatment, had co-existent psychological and/or psychiatric conditions such as anxiety and depression. In some TMD sufferers the major complaints were of chronic pain, while in others there was marked TM joint deterioration. Similarly, studies on stress and TMD have also reflected positive associations. In an extensive review of the literature on TM disorder, Rugh and Solberg (1976) concluded that TMD could only be fully appreciated by utilizing a multifactorial approach, and that "...it is appropriate to examine emotional, behavioral and interpersonal relationships in parallel, not as dichotomous concepts" (p. 26). A full evaluation of TMD should include not only a physical examination, but also consideration of emotional and situational factors, as well as the patient's usual coping style regarding pain and illness. This has important treatment implications since treatment must also be broad-based and utilize multimodel therapies including physical and psychological remedies.

Pain and TMD

In tempormandibular disorders pain is the most common manifestation (Greene, Lerman, Sutcher & Laskin, 1969). The pain may be unilateral or bilateral, sharp and acute, or manifest as a dull ache. It may radiate over the face, extend to the temporal regions of the head, radiating forward to the ear. There are a number of theoretical viewpoints that explain the pain of TM disorders. Early theories postulated that the pain was as a result of pressure on the ariculotemporal and chorda tympani nerves, transmitted by pressure of the bones in the temporal areas of the cranium. It has also been suggested that the pain is caused by swelling and pressure on the nervous tissue present in the posterior part of the capsular ligament, or in the sensitive tissue behind the condyle. Other theorists have suggested that inflammation of the capsular ligament itself caused the pain (Moss & Garrett, 1984). Other theories including that proposed by Schwartz in 1955, postulated that spasm in the masticatory muscles was responsible for the pain. The lateral pterygoid is the muscle most often tender on palpation. As the muscles are in a state of spasm, blood flow may be inhibited, trapping toxic products which could induce pain (Eversole & Machado, 1985). However, this has not received much support, as teeth clenching and bruxism increases blood flow through the muscle rather than decreases it, yet still produces pain. An alternative approach is that of Yemm (1969a, 1969b, 1969c), who suggested damage to the muscle fibres rather than spasm itself, might have produced the pain. Finally, the pain has been related to the inflammation response that occurs in the damaged tissues, resulting in increased capillary permeability and increased blood flow, causing an increase in fluid pressure, which stimulates the nerve endings. However, as reviewed in Melzack's work, pain, especially chronic pain, is a very complex process and it is probable that TMD pain has both psychological and physiological factors (Melzack, 1989b).

Historically pain has been considered to have strong psychological characteristics. Turk and Rudy (1986, 1987) commented that Aristotle considered pain to be an emotional reaction that could be dealt with through cognitive processes. On the other hand, the philosopher Descartes suggested that pain was physiological and the amount of pain reflected the extent of injury or damage to the end organ. The latter view has predominated in medical science, although some account has been taken of pain that does not seem directly related to tissue damage; so called psychogenic pain. Turk and Salovey (1984) pointed out that the term psychogenic tended to be reserved for unexplained pain. They also pointed out that psychogenic pain may have physiological components and because of present limitations in technology we are unable to find the cause.

The definition of pain is still somewhat obscure. Pain has been defined as a physical sensation reflecting noxious stimuli being applied to an organism and a notice of impending danger. In human terms, pain is extremely complex and involves cognitive and emotional parameters (Mersky, 1978). Pain is the most common health complaint in our culture. The most common pains are backaches, followed by headaches, abdominal, chest and facial pain (Von Korff, Dworkin, LeRescle & Kruger, 1988). Pain has objective components including the physiological response to the pain, which has sensory, motor and autonomic nervous aspects, and subjective responses which have psychosocial components. The objective pathways for pain include peripheral and central nervous system components. For example, pain memory is stored in the temporal lobe of the brain. The site and nature of the pain is identified in the sensory cortex. The autonomic response to pain is in the hypothalamus, and emotional pain response belongs in the pre-frontal lobes (Melzack & Wall, 1973; Mersky, 1978).

The concept of pain in humans is even more complicated since pain is modulated at a number of different levels on its way to the central nervous system. Turk and Rudy (1986) reported on the work of Beecher, who during the second World War suggested that pain had two components: (a) a primary physiological sensory component, and (b) a secondary emotional component. Psychological factors could then modify the pain regardless of the cause.

Melzack (1989b) considered pain under three major psychological subdivisions. These were (a) sensory-discriminitive (rapidly conducting spinal system), (b) motivationally-affective (slowly conducting spinal systems to limbic and reticular systems), (c) cognitive-evaluative (neocortical or higher center innervation). The latter would be responsible for evaluation of pain messages in light of previous expectations, motivations and attitudes towards pain (Melzack, 1989a).

In their Gate Control theory of pain, Melzack and Wall (1973) stated that neuronal mechanisms existed in the dorsal horns of the spinal cord which modified pain awareness even before it reached the brain. These mechanisms existed at various levels in the spinal cord and were acted on by afferent nerve fibres coming from the brain. This theory suggested that large fibre impulses closed the "gate" and small fibre impulses opened it. It was only when enough nerve impulses reached the brain that pain was perceived. Pain may be decreased by the afferent fibres, which originate in a part of the brain stem known as the periaqueduct gray matter. This is also the location at which morphine acts and which produces natural opium-like substances including endorphins and enkephalins. This mechanism explains the effects of acupuncture and Transcutaneous Electrical Nerve Stimulation (TENS) which appear to stimulate the production of endorphins. Therefore, the pain experience may be modified by central nervous system input, regardless of the seriousness of the injury or trauma to the affected part of the body. This has been shown, for example, in athletes who do not feel pain from injuries sustained during their particular sport, and soldiers whose pain perception was less than civilians with similar injuries, since the pain effectively relieved them from the stress of returning to battle (Mersky, 1978).

One must also distinguish between acute and chronic pain. Acute pain is divided into two phases, an acute rapid phasic stage and a tonic, slower resolution stage. Acute pain is characteristically short-lived and ceases when the cause is removed. However, when the noxious stimulus is removed the pain persists or spreads, and may be associated with psychological syndromes including anxiety and depression (Turk & Flor 1988). Melzack (1989a) suggested that acute pain was modulated by rapid firing neurones so that the brain quickly received information about danger to the organism. However, the sensation felt in chronic pain was related to more slowly firing neurones and may have served the function of protecting the organism from further damage and promoted rest to help healing. Therefore, chronic pain may be modified by mechanisms unrelated to the presence of trauma. It has been shown that even when nerve input is severed nerve cells may fire on their own, generating pain signals because of previously established programming as in "phantom limb" pain (Melzack, 1989a).

It has been observed that subjective reporting of pain may have little relationship to the actual extent of the pain based on organic pathology. This "operant pain" may be controlled directly by reinforcement. Fordyce et al (1984) described the term "pain behaviors" as the total experience of pain and its communication to others. Pain behaviors according to Fordyce included verbal complaints, moans and sighs (paraverbal sounds), body posture such as grimacing and limping, and pain alleviating solutions including administration of medications. Two learning models of pain behavior have been described: (1) classical conditioning and (2) operant conditioning. The classical conditioning model of pain assumed a direct relationship between injury (the unconditional stimulus) and pain, the unconditioned response. The pain also caused autonomic arousal including anxiety and muscle tension, leading to immobility of the affected part. The individual recognized that certain situations (i.e., heat, cold, movement) effected the pain. These in turn became conditioned stimuli, and may have brought about pain responses without any actual physiological cause (Turk & Flor, 1987).

Fordyce et al (1984) suggested that chronic pain behavior might also have been governed by classical conditioning. They commented that pain was not directly observable and it was the person's pain response that we observe rather than the actual pain itself. Inferences are then made about the extent and quality of tissue damage.

The operant conditional model of pain stated that pain responses were learned based on a number of factors including the secondary gain established by the behavior. These factors might also have involved increased attention, work avoidance, and sympathy. Speculand et al (1983) investigated illness behavior in TMD patients and controls, and showed that in the TMD patients there was significant increases in illness conviction, anxiety, and depression. The TMD patients were more likely to deny life problems or emotional concerns. They also found that increased illness conviction was significantly correlated with failure to respond to conservative treatment.

Rugh (1987) conceptualized a multidimensional model for pain in which he divided pain factors into seven dimensions. These were (a) the pain stimulus, (b) the receptor system, (c) the perceptual sensory system, (d) the cognitive process, (e) the motivational-affective component, (f) the behavioral response system, and (g) the influence of the environment. Each of these factors may have altered the experience of pain for the individual. As already noted pain perception may be altered by interference at a number of different levels. In human beings the cognitive processes are important as attention, previous learning, and cultural values could also effect perception of pain. Pain can be eased by distraction and may be increased by focusing on it. Rugh (1987) used the term "apprehensive disuse atrophy" to describe a condition where patients following TMJ surgery, remained on a soft diet long after it was necessary. Atrophy was consistent with the patient's beliefs that use of the affected part would worsen their condition. Rugh quoted the work of Ciccone and Grzesiak, who stated that mistaken beliefs or inferences are a very important factor in chronic pain conditions, and that worry and negativity can, in themselves, cause autonomic arousal and muscle spasm, which worsens the pain.

Consideration must also be given to affective and emotional components, since an individual's emotional state can affect pain awareness and the perceived severity of pain. This is related to the significance of the pain to the patient. Pain may also occur in the absence of any obvious trauma or noxious stimulus, because of emotional problems including depression and anxiety. Patients with high anxiety levels have a lower pain threshold than low anxiety patients, and 80% of abdominal pain in children has been attributed to emotional factors, including school based anxiety (Levine, Carey, Crocker & Grossi, 1983).

Rugh (1987) also noted that people's beliefs have a great deal to do with pain perception, so that a person who thinks that his pain is caused by a potentially life threatening condition, and a patient who, for example, has tooth ache pain, may react very differently to pain of equal intensity. A further consideration is the individual's perceived control over the pain. Rugh and Lemke (1984) reported that patients' headaches could be reduced if they were told that they had responded well to EMG biofeedback training, while in patients who were told that they did not do well, pain was not reduced. Neither group was actually given biofeedback. They summarized the situation by commenting that "...pain is a series of complaints and behavioral patterns presented by the patient" (Rugh & Lemke, 1984 p. 952).

The previous theoretical perspectives tend to focus on only some aspects of pain. The Gate Control theory emphasizes the influence of cognitive and emotional processes on the physiological pain response, while the operant conditioning model focuses on behavioral reinforcement of pain behaviors, whether or not an actual cause for the pain can be found.

A further perspective on pain is provided by the Cognitive Behavioral Integrative model. This model expounded by Turk and Rudy (1986) has a multidimensional framework and incorporates cognitive and emotional responses, attitudinal and belief systems, behavioral variables, and the surrounding environmental response to an individual's pain. The individual's integration of all these factors leads to his or her perception of the quality and quantity of their pain.

Flor, Haag, Turk and Koehler (1983) studied patients with chronic back pain, non-back pain patients, and normal controls. They used four types of measurement: (1) EMG reactivity of frontalis and (2) paraspinal muscles, (3) heart rate, and (4) GSR. Psychological evaluation included measurements of anxiety and depression. They used four different conditions. These included (1) discussion of personal stress, (2) discussion of pain, (3) mental arithmetic, and (4) recitation of the alphabet. They also had a control condition. They found that back pain patients showed increased muscle hyperactivity when they discussed pain and personal stress, but not under other general stress conditions. The severity of the muscle reactivity was related to depressive mood and cognitive coping style, rather than duration of pain or number of surgeries. Mercuri et al (197[illegible]) found similar results in TMJ patients. In this case, the muscle hyperactivity was seen in the TMD muscle groups.

Flor et al. (1983) have suggested that although the increased EMG response in the affected muscles is seen in response to psychological variables, the psychological factors were not primary causes of the pain, but that the muscle spasm exacerbated the actual sensory pain experience. The pain may then become a new stressor, which perpetuated the cycle, and created a feedback loop. They also pointed out that pain on movement may lead to decreased mobility, resulting in muscle atrophy. Also, the inability to move the affected part might curtail everyday activities, and lead to increased feelings of helplessness. This in turn, caused depression of mood, and the patient became preoccupied with the pain. Proof of this is seen in biofeedback studies of individuals with chronic pain. These studies suggested that when patients were taught methods of controlling pain, their sense of helplessness was diminished, although muscle tension often stayed the same (Holyroyd et al, 1984; Holyroyd & Andrasik, 1978; Flor et al, 1989). This suggested that it was the alteration of the patient's attitude to the pain that alleviated suffering, rather than any change in the pathological processes that caused the pain. Turk and Rudy (1986) reported that cognitive behavioral treatment of pain patients, not only reduced patient's reports of pain, but also affected improvement in physical functioning, use of helping facilities and reduction of pain behaviors.

Theories of Stress and TMD

Research has shown that stress is a significant factor in the production of temporomandibular disorders, and 50% to 75% of TMD patients reported stressful life events which preceded the onset of symptoms (Speculand & Goss, 1985). The most common problems were disappointments at work, economic and health concerns, marital conflict, bereavement, and relationship problems (Geissler, 1985; Stein et al, 1982).

Marbach et al (1988) stated that TMD patients reported more pain-related illness, life threatening physical problems and other physical illnesses than non-TMD patients. These researchers studied 151 subjects suffering from TMD and compared them with 139 healthy controls. An extensive battery of psychological tests was administered including life events, personality and emotional measures, and a locus of control scale. Results indicated that there were no differences in numbers of life events between each group. However, results indicated TMJ patients had significantly fewer emotional supports, had an external locus of control, and were more likely to attribute their symptoms to physical rather than psychological problems. There were more illness and injury events in the past histories of TMJ patients, and they would grind their teeth more often than controls (Marbach et al, 1988).

Speculand et al (1983) and Speculand and Goss (1985), in two studies found evidence that TMD patients demonstrated abnormal illness. In the first study 100 TMD patients were compared with 100 controls, and in the second study 85 TMD patients were compared to 85 controls. Attitudes towards illness and health were measured using the Pilowsky Illness Behavior questionnaire and Paykel's measure of Life Events Inventory. In both studies TMD patients were more preoccupied with health and illness symptoms, had a higher disease conviction, were more inclined to deny stress in their lives, and preferred somatic explanations for their problems. These studies also concluded that TMD patients had twice as many stressful life events than the controls. Berry and Wilmot (1977) reported that the incidence of migraine in TMD sufferers was ten times higher than in the normal population, which suggested that a strong relationship existed between headaches and TMD. This was also shown by Lundeen et al (1987), who showed that individuals with muscle pain often suffered from other stress related disorders such as back pain, migraines and gastric ulcers.

Schwartz (1955, 1956) was one of the first researchers to link chronic anxiety and nervous tension with TMD. He suggested that TMD occurred as a result of emotional stress. This caused the muscles to become hyperactive, resulting in muscle spasm. This, in turn, led to muscle imbalance and strain on the temporomandibular joint, eventually leading to TM disorder. The primary role of stress in TM disorders was also expounded on by Laskin (1969), who developed the psycho-physiological model of TMD. He introduced the term Myofacial Pain Dysfunction. In Laskin's model TMD was produced as the end result in a series of events which began with stress and led to muscle hyperactivity and myospasm caused by muscle fatigue. The resultant chronic muscle spasm then led to pain, occlusion problems, and often internal derangements (Laskin & Block, 1986). These two theoretical positions viewed stress as the starting point for TM disorder and gave credence to treatment of TMD by alleviating the myospasm, using relaxation therapies and biofeedback.

Lundeen et al (1987) also found significant relationships between stressful life events and the onset of TMD. They reported on Haber's model (Haber, Moss, Kuczmierczyk & Gerrett, 1983) which suggested that excessive stress resulted in masticatory muscle hyperactivity. This caused teeth clenching and grinding which in turn led to muscle and joint pain, limitations of the range of jaw motion, and joint sounds (Lundeen et al, 1987).

Stein et al (1982) used the Holmes and Rahe Social Readjustment Scale (SRRS) (Holmes & Rahe, 1967) to assess the level of life changes in sixteen patients who received treatment for TMD, and eight controls. They found a significant difference in the mean scores between the treatment and control group. An association between the life events and the number of symptoms was present, although the relationship of the significant life events to the onset of TMD was not known.

Further evidence of the importance of life stress and TMD can be seen from treatment studies. A number of different psychological techniques have been used with varying success. These included traditional psychotherapies, hypnosis, behavioral relaxation therapies, and biofeedback training. Relaxation training and stress reduction with biofeedback was shown to be particularly successful in alleviating pain and muscle tension (Funch & Gale, 1984).

A relationship has also been found between stress induced myospasm and TMD. Yemm (1969 a,b,c) found that increased tension of the facial muscles could be brought about by experimentally induced stress in normal subjects. More recently, Mercuri et al (1979) demonstrated that TMD patients showed significantly higher masseter and frontalis muscle EMG activity at rest, compared to normal controls. This suggested that patients with TMD had a higher degree of muscular reactivity than normal subjects, and a chronic high arousal level. TMD muscle pain patients have often been found to have a response specific reaction to a repeated stressful stimulus (Yemm, 1969a, 1969b, 1969c).

In musculo-skeletal systems such as the temporomandibular system, in reaction to stress there are changes in muscle tension associated with the fight-flight response. This involves an initial increase in blood flow (phase 1 of the General Adaptation Syndrome). This is followed by the resistance phase (phase 2 of Selye's General Adaptation Syndrome), leading to a reduction in the blood circulation in the effected muscle. Normal toxic metabolites produced by muscle activity are left behind in the muscle since the blood flow is not sufficient to clear them out, which often produces muscle pain (Seyle, 1976). Therefore, chronic tension may lead to muscle spasm because of the forces on the joint exerted by the chronically contracted muscle. This can eventually produce joint derangement. This model may suggest a physiological basis for Laskin's explanation of the Myofacial Pain Dysfunction Syndrome (MPDS) (Laskin, 1969).

Parafunctional habits such as teeth bruxism and clenching have also been implicated in the myospasm and pain associated with TMD. Eversole and Machado (1985), postulated that bruxism was caused by stress and anxiety, and served to lower anxiety levels. The bruxing then led to muscle inco-ordination and muscle spasms. These localized explanations of TMJ pain and dysfunction have been described as "micro-traumas" (Moss & Garrett, 1984).

Bruxism or teeth grinding, may be nocturnal, diurnal, or both. It occurs in approximately 5% to 20% of the adult population and 12% to 15% of children aged 3 to 12 years. TM dysfunction occurs in about 5% of individuals who brux. Laboratory sleep studies in adults have shown that nocturnal bruxism was related to the amount of stress experienced during the day. This research indicated that in planning a course of treatment for the patient with TMD who suffer with bruxing, a stress management component must be included (Rugh & Harlan, 1988; Rugh & Lemke, 1984).

Stress in Adolescents

Adolescence has been defined in both biological and socio-cultural terms. Biologically adolescence is that period of life that begins with the onset of puberty and ends with full physical growth. From a socio-cultural viewpoint adolescence marks the transitional period between childhood and adulthood which has been defined largely by societal norms, and may vary from culture to culture depending on economic and societal conditions. In western cultures adolescence is generally taken as occurring between ages 12 and 18 years, encompassing major biological, psychological, and social change (Kaplan & Saddock, 1985). Psychologically adolescence has been divided into three phases: (a) early adolescence, from the onset of puberty until approximately 14 years of age; (b) middle adolescence, from 14 to 16 years, and (c) late adolescence, between 16 and 18 years of age. Specific developmental tasks have been described for adolescence including the need to separate from the family of origin, development of autonomy, identity and peer relationships, and eventual vocational goals. Adolescence is also a period of great cognitive change, especially the development of the capacity for analytic thought. All adolescents must negotiate the specific developmental tasks according to their own potential. Successful negotiation of adolescent developmental tasks is considered an essential pre-requisite for emotional growth and maturity (Blos, 1979). Coddington (1972) reported that adolescents reported more life change events as a function of age until middle adolescence when the life change events levelled out. He also showed that in children and adolescents the significance of different life events changed with age and development. In preschool and elementary school children the most significant events related to separation and divorce of parents. In junior high school the highest stressful events were death or divorce of parents. In senior high, on the other hand, pregnancy and getting married replaced parental events as most stressful, except for death of a parent which remained high. Compas (1987) pointed out that from infancy, humans are exposed to potential threat situations that must be adapted to in order to ensure survival. He suggested that whether an individual was successful in negotiating these events depended on the ability to handle and develop strategies to deal with these various threats. He defined coping as "...any and all response made by an individual who encounters a potentially harmful outcome" (p.393). Compas suggested that coping should be considered under three headings: (a) effortful and effortless responses, (b) coping function, and (c) focus on resources, styles, and specific stressors. Effortless responses included instinctual and reflexive mechanisms present at birth, including the withdrawal reflex. Effortful responses included behaviors which were learned, but were still responded to reflexly, such as pain avoidance. The combination of these factors would influence the child's ability to deal with stress. Coping responses were also mediated by the development of various skills including problem solving, interpersonal skills, self-esteem, social environment, and consistency with biological and psychological make-up. This included temperament and any possible genetic or constitutional factor that might impede development, such as illness or handicap. Compas (1987) summarized the research on stress and coping in children. This included the effects of the infant's response to maternal separation, actual social support, cognitive and problem solving skills, achievement, personality type as in type "A" behavior, repression-sensitization, resilience and vulnerability. He reported for example, that infants with poor attachment abilities were more easily upset by maternal absence than individuals with secure attachment. Children as young as four years old could develop alternative solutions to problems. However, he suggested that the ability to problem solve interpersonal difficulties does not become possible until eight to ten years of age.

Dweck and Wortman (1982) distinguished between two types of children; (a) helpless children, and (b) mastery-oriented children. The former, when exposed to stressful situations exhibited reduced effort to cope, were easily discouraged, and showed a deterioration in performance. Mastery-oriented children on the other hand, generated increased motivation, were persistent in efforts at problem solving, and showed increased concentration and enhanced performance when challenged by stress (Dweck & Wortman, 1982).

Rutter (1987) showed that the individual child was not a passive recipient of stress, but rather had an active role to play in the total process. He suggested that consideration must also be given to a number of other factors which included constitutional variability, vulnerability and resilience, and protective influences induced by the environment. He stated that "...experiences changes the organism, but it is equally clear that people create their environments" (p. 326).

Three different components of resistance to the negative effects of stress were defined. 1) Resilience, which is the positive role that individual differences play in peoples' responses to stress and adversity. In this context, resilience is concerned with the child's individual response to stress. 2) Vulnerability, which is the modification of the person's response to the risk situation and protection related to those aspects of the individual or environment which serve to defend against the deleterious effects of stressors. 3) Protective factors which included personality characteristics such as self-esteem, family cohesion, the absence of discord, and the availability of external support systems that encourage and reinforce a child's coping skills (Rutter, 1987). He reviewed a large number of studies outlining variables that effected protection. These included sex, temperament, family support including parental cohesion and harmony, school relationships, and ability to cope with life turning points.

Rutter (1987) also pointed out that boys were more likely than girls to develop emotional and behavioral disturbance when exposed to marked family discord. It has been suggested that this is related to a greater likelihood of neuro-developmental impairment in boys. Also, parents were more likely to quarrel in front of boys than girls. Boys were more likely to be placed in institutions when families were dysfunctional, increasing the risk for psychopathology. Boys also tended to express their discomfort in behavioral rather than emotional terms, eliciting negative reactions which led to placement outside the home. The work of Chess and Thomas (1986) on individual temperamental variation in infants has made it possible to recognize personality styles in early life. Rutter (1987) also found that children with adverse temperamental features including low regularity, low malleability, negative moods, and low frustration are more likely than other children to be the target of parental hostility, criticism, and other negative factors which contributed to psychological breakdown. Good marital relationships exercised protective effects on children regardless of presented stress. The availability of even one parent to engage in a supportive, unconditionally accepting relationship is an important protective factor against psychopathology (Rutter, 1987). Factors such as early parental loss are relevant in later adult depression.

However, the ill effects of parental loss in early childhood seems to stem from the lack of affectionate care, or from the institutional admission that follows the loss in some cases, and not the loss itself. Positive school experiences are a strong protective factor for the child, both academically and with regard to extra-curricular pursuits. The well-organized and structured teenager with strong, specified interests is at far less risk for psychopathology than one who is failing academically and has few interests (Hurrelman, 1989). The ability for personal decision making allows successful negotiation of life stress possible. Previous adverse life experiences make it more likely that an individual would act in ways that may create threatening situations for themselves. There are a number of mediating influences that may lessen the risk of any stressor leading to a stress reaction, or to physiological or psychological decompensation. These included "inoculation" against stress by controlled exposure in such a way that successful adaptation is possible. This in turn leads to increased rather than decreased self-esteem, and a sense of self-accomplishment. Secure, positive relationships, successful accomplishments of tasks important to the individual, and opportunities to successfully negotiate the stressors are also important (Rutter, 1986, 1987; Sandler & Ramsay, 1980).

Smith (1986) reported that adolescents' visits to physicians were often related to psychophysiological symptoms which included headaches, chest and abdominal pains, or dizziness. He found that these were physiological reactions to anxiety. Hurrelman et al. (1988) found that the frequency of psychosomatic illness in adolescents was positively correlated with academic failure, and conflict at home and with parents. These authors stated that "...against the background of increased competition in the labor market in recent years, the inter-connectedness between school failure and the quality of family relationships revealed here has become progressively more significant" (p. 248).

Mechanic and Hansell (1987) studied 1,057 adolescents who were doing well in school and were involved in sports and social interests. It was found that they were in better physical and psychological health than those who did not do well.

Minuchin, Baker, Rosman, Lieberman, Milman and Todd (1975) pointed out that in considering the relationship between psychosomatic illness in children, that family relationships were most important. These authors believed that linear models of causation were too narrow and that an open system existed with a capacity for various levels of feedback between the individual and his or her environment. In the open systems model as described by these authors, certain family organizational patterns were related to the development of psychosomatic illness in children, and that the illness in essence kept the family together. They summarized this by stating that "...family interaction patterns may trigger the onset, or hamper the subsidence of psychophysiological processes, or both" (Minuchin et al, 1975, p. 1032). They treated a number of children with brittle diabetes and reported on four particular family characteristics that were observed. These included (a) enmeshment, (b) over-protectiveness, (c) rigidity, and (d) lack of conflict resolution. Enmeshment implied a lack of differentiation between family members with poorly defined boundaries. Over-protectiveness was common in psychosomatic families, with a great interest in physical symptoms in particular. Rigidity described the family's unwillingness to change to accommodate the child's developmental growth. Such families were described as similar to somatizing adults as they denied psychological symptoms or distress, but focused on the ill child which kept their stress level under control. Problems were often unresolved as such families had a low level of stress tolerance. In general, illness provided a safe method of communicating feelings.

Hurrelmann (1989) studied a large group of 13 to 16 year olds in West Germany and found that those children who were not doing well at school had more somatic complaints. These included headaches and other psychosomatic ailments. He stated that "...the data supports the hypothesis that psychosomatic symptom frequency is reinforced when adolescents experience failure in school and social, and emotional conflict in their relationships with parents" (p. 47).

It appeared then, that good health and subjective sense of well-being developed by strengths in physical, psychological, and social areas was an important mediator in the individual's reaction to life stress. It was the interaction of all these variables that would determine the way in which an individual coped with stress, rather than the actual stress itself (Fleming, Baum & Singer, 1984).

Numerous studies have demonstrated a relationship between life events, measures of health and illness, accidents, and psychological disturbance in adolescents

(Gad & Johnson, 1980; Johnson & McCutcheon, 1980). Heisel, Ream, Raitz, Rappaport & Coddington (1973) studied five different groups of child patients with physical illness. Children with rheumatoid arthritis, hemophelia, general pediatric patients, surgical, and psychiatric patients, were compared to "normal" controls. They found that the sick children had significantly more stressful life events than normal controls, and that 34% of the children developed their illness in the year following their life stresses. Hotaling, Atwell and Linksky (1978) examined stressful life events and illness in an adolescent population. They postulated three possible models for the production of stress-related illness: (a) a direct illness stress model, (b) a sick role model, and (c) a mental health model. The first model assumed that a simple relationship existed between amount of stress and vulnerability to illness. The second model assumed that when individuals became dissatisfied or had apparently insurmountable problems, they developed illness behaviors. Subsequently, they linked their problems to illness and used physical symptoms to avoid their problems. The third model, the mental health model, was based on the idea of physical illness as an expression of emotional problems, particularly depression. This research supported the direct stress-illness model, but did suggest that intervening variables were important. These authors found that good social supports, especially family support reduced the chances of stress-induced illness from 77% to 50%. Bedell, Giordani, Amour, Tavormina & Boll (1977) examined the relationship between psychological and medical adjustment of children who were chronically ill. Results showed that the children with a high level of life stress had a poorer self-concept and experienced more acute symptoms with their illness.

Psychological dysfunction in children has been related to external locus of control, increased level of subjective and objective life events, and lower interpersonal problem solving ability (Mullins, Siegel & Hodges, 1985). Undesirable life events which are independent of illness may have a significant negative impact on children and may have causal connections to psychological and psychiatric dysfunction. Bedell et al (1977) pointed out that the impact of the event depended on any buffering factors which influenced the individual. Particular stressors of importance included parental divorce, birth of a sibling, and hospitalization (Goodyer, Kolvin & Gatzanis, 1985). However, Kashani, Hodges, Simonds & Hilderbrand (1981) compared life events in three groups of children: (a) psychiatric, hospitalized patients, (b) pediatric, hospitalized children, and (c) a group of healthy children. They concluded that life events alone were insufficient to infer a causal relationship in onset of illness and hospitalization of children. Scaloubaca, Slade & Creed (1988) examined University students who attended a University Health Centre and found a large proportion with abnormal illness behavior and psychiatric problems. In particular students with physical symptoms without obvious physical cause, had experienced a recent loss of a significant relationship. Coddington (1972) showed that physical illness was not sufficient in itself to cause stress in children, but that associated events which included social-environmental influences were important in predicting which children would relate to their illness with psychological dysfunction.

Hurrelmann (1989) suggested that success at school, extra-curricular activities, family support, and the ability to form lasting, intimate relationships were most important in ensuring healthy growth regardless of levels of environmental stress. Good physical health was also found relevant, as was a positive attitude to life in general (Mendez, Yeaworth, York & Goodwin, 1980). Newcomb, Huba & Bentler (1981) investigated a sample of 1,000 children and the occurrence of major life events in the previous year. They noted that negative events were more strongly associated with dysfunction than positive events. The greatest association was between negative events and depression.

In a later paper Newcomb, Huba & Bentler (1986b) studied the perceived desirability or undesirability of life events in 1,018 adolescents in the 10th, 11th, and 12th grades. Results showed that the most undesirable events were contraction of venereal disease and death of a family member. The most desirable life events were learning to drive and owning one's own television or stereo. Gottlieb (1981) was able to demonstrate that social support acted as a protector, mediating the relationship between life events and disorder. He coined the term "buffering hypothesis". This was further researched by Coddington (1972), who studied a large mixed gender sample of high school seniors. He found an association between negative life events and psychological problems including depression, anxiety, obsessive compulsive disorder, interpersonal sensitivity, and anxiety. Results from this research suggested that lower levels of social support were significantly related to psychological dysfunction, especially involving other family members, school problems, or legal difficulties. Overall, males reported fewer life events than females, but showed higher levels of dysfunction. Coddington's results differed from those of Johnson and McCutcheon (1980), who found that negative events were more strongly associated with physical problems in males, and psychological problems in females.

More recently Newcomb et al (1986a) critiqued the literature on stress in adolescents. They pointed out that studies have not distinguished between the perceived control over the life event that causes stress, the contamination by other problems including poor physical health and psychological difficulties, and a lack of consistent and reliable measures. They stated that four areas of concern were relevent in life events research: (a) the role of personal control over events, (b) the problem of differentiating confounding and outcome variables, (c) the need for consistent and reliable measures, and (d) the necessity of cross-validating research. They investigated whether or not this was so in a study of adolescents and life stress, and identified seven dimensions of stressful events. These included (a) family and parents, (b) accidents and illness, (c) sexual events, (d) autonomy, (e) deviance, (f) relocation, and (g) distress. They found that the family and parents factor was associated with headache proneness, insomnia, depression, illness sensitivity, and lack of trust in physicians. Total life event scores were associated with headache proneness, illness sensitivity, and thought disorganization. Results also showed that controllable events were not associated with poor health. The total life events sum score was associated with drug use, as was the deviance scale. Increased life events scores were associated with increased vulnerability, depression, and personality disturbance.

In summary it can be seen that stressful life events and illness are associated. However, a simple cause-effect relationship cannot be used to describe the influence of life events on illness in children and adolescents. Factors such as constitutional make-up and psychological stability are also important. In particular the desirability or undesirability of specific events, the child's coping ability, vulnerability and resilience, and sense of control over the life events are amongst the many variables that also must be taken into account.

Models of Stress;

Socrates in 400 B.C. is quoted as saying, "As it is not proper to cure the eyes without the head, nor the head without the body, so neither is it proper to cure the body without the soul" (Kaplan & Saddock, 1985, p. 1107). This indicated that ideas of the relationship between mind and body in illness are not new. In fact in early times, all illnesses were seen as the result of the influences of bad or evil spirits which entered the body and caused the illness. Treatment was often aimed at trying to rid the body of the bad spirits by both medicinal and magical means. Also during the middle ages, the church reinforced the concept of illness as a punishment for sins and looked negatively on attempts to produce physical and scientific explanations for physical illness (Kaplan & Saddock, 1985).

The real separation of mind and body in illness began in the 15th century as investigations were made into human anatomy and physiology. This was encouraged by Descarte's philosophical ideas which differentiated the soul from the body, the soul being placed in the pineal gland. Later advances in medicine reinforced the mind/body dichotomy, particularly with the discovery of bacteria as a cause of infections. The result of these scientific advances was that physical or bodily illness became separated from psychological or mental illness.

There is a growing consensus of a link between life stress and physical and psychological illness for all age groups . Interest in the role of stress in the production of illness has now permeated all levels of society and "stress" has become a household word. Research reported that at least 40% of visits to family physicians were psychological (deLeon et al, 1987). Many of these patients could be shown to have stress related disorders and often attributed the beginning of their illness episode to specific stressful life events (Cooke & Hole, 1983). However, while stress is spoken of in very general terms and in a lay sense is self-explanatory, the same is not true from a psychological perspective.

It was not until the early 19th century that the term "psychosomatic" was used by Heinroth as an explanation for insomnia. The first real advance in psychological thinking was induced by Charcot's experiments with hypnosis, and Sigmund Freud's subsequent theoretical formulations for the causes of hysterical conversion reactions. From this early research there is a growing consensus that there is indeed a link between life stress and physical illness.

Early models of stress and illness followed two main pathways. The first, adhering to psychoanalytic tradition, suggested that psychological factors were related to suppressed emotion or early conflict and trauma that led to physiological reactions in predisposed organ systems. This view suggested that personality factors were directly related to the illness produced. It was considered that in passive-dependent personalities, stress caused a parasympathetic reaction and the production of excess stomach acid, which caused ulcers. In other cases stress was the cause of sympathetic over-arousal, with vascular constriction and conditions such as migraine headaches (Kimball, 1982). Alexander defined stress as "...relating to an event external to the organism, but correlating with identifiable, measurable responses in a vulnerable organ system" (Kimball, 1982, p. 64).

Hans Selye (1976) suggested that stress was a non-specific hyperarousal state that involved both parasympathetic and sympathetic responses and direct hormonal influences. This model viewed stress as a reaction of the organism to any noxious stimulus and a necessary protective response of the organism to perceived danger. Selye's model emphasized the role of chronic stress in illness when the body's responses to stress were overwhelmed, which caused exhaustion. Selye used the term "general adaptation syndrome" to describe the total physiological response to stress. He recognized that stress had both positive and negative components. Selye suggested that each individual had an optimal level of stress related to genetic, biological, and acquired physiological and psychological responsiveness. The stimulus which caused the stress was called the "stressor"

Traditional models of stress viewed health and disease as dichotomous variables. In particular, the medical model adopted a linear or simple cause/effect approach. In this model illness was seen to be the result of specific disease processes stemming from a single causal agent which produced organic malfunction or pathology (Hurrelmann, 1989). Diagnosis was made by exclusion and if organic pathology was ruled out, the problem was presumed to be psychological. This linear model gave rise to early psychosomatic concepts of illness which viewed it as a reaction to unresolved conflict from childhood traumas which had disappeared into the unconscious. They were then expressed as somatic symptoms. It was assumed that there was organ specificity depending on the developmental level at which the trauma occurred, and that the physical symptoms were, in fact a symbolic representation of the unresolved conflict (Kaplan & Saddock, 1985). However, later research showed that the relationship between stress and illness was much more complex. For example, (a) a specific stressor may have caused symptoms in one individual, but not another, (b) the same psychosomatic reaction (i.e., ulcer) may have developed in two individuals as a result of different stressors, so that one person may have suffered a significant loss, while another may have had economic problems (Hurrelmann, 1989).

A large retrospective study was carried out to determine how health was affected by stress and measured events in an individual's social environment. Patterns of absenteeism of 2,000 male and female employees of the Bell Telephone Company found that the majority of absences occurred in a small number of individuals who had many experiences which they deemed to be stressful, especially as related to family and job satisfaction (Hinkle, Christenson, Kane, Ostfeld, Thetford & Wolff, 1958).

Holmes and Rahe (1967) suggested that it was the amount of stressors, or life changes, that determined when the individual was overwhelmed by stress, and illness occurred. They suggested that "...any set of circumstances, the advent of which signifies or requires change in the individual's ongoing life pattern would lower body resistance and precipitate the onset of illness" (p. 214). The life event was considered the factor that influenced the timing and onset of symptoms. The more changes, the more vulnerable the individual became. Holmes and Rahe (1967) viewed the impact of events as addictive and saw the temporal relationship between the environment and illness. However, they failed to consider mediating factors that might intervene between the life event and the symptom, although Selye had pointed this out in his earlier work.

During the last 30 years there have been over 40 retrospective studies of stress, life changes, and illness, using Holmes and Rahe's Schedule of Recent Life Events and Social Readjustment Scale (SRRS). These have been carried out in the military, industry, and with hospital personnel and patients. The SRRS is a 43-item questionnaire with each life event given a weighting. It produces a total Life Change Unit (LCU) score. The higher the LCU the more one is at risk to develop health problems. Modest, but statistically significant relationships have been shown between the magnitude of the LCU score and sudden cardiac deaths, myocardial infarction, accidents, multiple sclerosis, leukemia, diabetes, other medical problems, and psychosomatic illness (Holmes & Rahe, 1967). Paykel, Myers, Dienelt, Klerman, Lindenthal & Pepper (1969) studied 110 non-psychiatric adolescents using a questionnaire that they developed, and found that in 22 subjects the onset of depression was proceeded by significant life events. They also found a relationship between negative life events and suicide.

In 1956 Greene interviewed adult patients admitted to hospital with leukemia. In the 20 cases he studied, the development of the illness followed exposure to multiple life events, especially loss of significant persons, usually by death. In a previous study conducted by the same researcher, patients demonstrated depression in the months preceding the illness (Greene, et al. 1956). Negative life events had also been related to coronary disease, hypertension, and tuberculosis, although in the former two genetic predisposition was a significant factor (Holmes, 1963; Russeck, 1960; Russeck & Zohman, 1958).

Lazarus, Delongis, Folkman & Gruen (1985) suggested that microstressors rather than life events might be important in predicting psychological and somatic problems. By microstressors, they referred to the small, everyday demands of living that caused worry and frustration. These included (a) being held up in traffic, (b) having to wait in lines, and (c) not getting enough sleeping. They developed a scale called the "Hassle Scale" that appeared to show a stronger relationship to psychological distress than the Life Events Scales.

Criticism could be leveled at much of the Life Events research. Firstly, because it was largely based on retrospective data, and secondly because of the statistical methods used. Rabkin and Struening (1976) reported that stress was only related to 9% to 15% of illness variance in the Holmes and Rahe's studies. They suggested that account must also be taken of mediating factors such as desirability of the events that occured. For example, divorce is considered a high stress event according to the Life Change Unit scales, but in some circumstances divorce may be perceived as a positive event and not be stressful to the individual concerned. Similarly, circumstances such as poor economic conditions or ethnic group may alter the desirability of life events.

Interactional Models of Stress

The early studies on stress were carried out on laboratory animals and consisted of applying a toxic agent externally or internally and measuring the physiological response. These laboratory studies suggested a simple cause/effect relationship. Stress was then defined as the physiological response brought about by exposure to the stressful stimulus. However, when considering stress from a human viewpoint, this simple model no longer suffices. Human beings are governed by the complex interaction of both physiological and psychological events, by their biological constitution, and environmental circumstances. Stress was seen as a psychological variable similar to emotion and motivation. Lazarus et al, 1985 described a model of stress as "...a conceptually rational and cognitively mediated phenomenon" (p. 778). Stress was then viewed as an interactional process between the individual and the environment. It was adaptational and no stressor or stimulus could trigger a response without interpretation and subjective appraisal by the individual. Stress was, therefore, a complex biopsychosocial phenomenon which involved physiological, cognitive, affective, and environmental components.

Early theories of stress and illness used a simple cause/effect model and did not account for the many intervening and mediating variables, both individual and environmental. More recently, research has focused on the view that health and illness are on a continuum. The healthy individual is at one end of the continuum and is able to cope with many different life situations to maintain a state of homeostatis, or equilibrium. The unhealthy individual on the other hand, has difficulty coping in general and this disequilibrium leads to maladaptive responses and eventually, pathology (Hurrelmann, 1989). This research focused on the reciprocal nature and dynamic interaction between the individual and his or her environment. Hurrelmann (1989) summarized this by stating that "...health and disease are the outcome of the interaction with stressors, in which the context, as well as the biography of the individual, play a role. The location of an individual on the "ease-disease" continuum is a result of the interaction" (Hurrelmann, 1989, p. 83). Based on this research, stress-induced illness cannot be explained using a simple uni-causal framework, but is both situational and interpersonally specific.

Utilizing a a cognitive model Lazarus & Folkmann (1984), have suggested that nothing is stressful unless the individual believes it is. These authors focused on the individual's appraisal and the subjective aspects of the stress for the individual. Appraisal in this context referred to the belief the individual had about the significance_of the event and included assumptions and past experiences. It was the imbalance between the perceived demands and resources of the person that determined and defined individual stress.

Starting with this perspective it is clear that during a time of stress, successful adaptation depends on perception and interpretation of potentially damaging events. This process of stress evaluation is called "primary cognitive appraisal". It leads to a second level which determines coping options. The individual might induce methods of coping based on past experiences and previous learning which reduced the adversive quality of the stressor. Stress appraisal depends on cognitive process including attitudes and belief systems. Lazarus and Folkman divided stress coping styles into two categories: (a) problem oriented coping which implied that the individual took some direct action designed to modify the stress directly, such as avoidance (i.e, an individual who was phobic of flying might use another means of travel); (b) palliative coping which involved the affective demeanor and regulation of emotions to take control of the situation. The stressful situation was accepted and responses were directed at managing or reducing the stress. In these authors' model, coping could be viewed as a dynamic process to deal with stress that differed based on the individual's circumstances and psychological makeup. Stress was considered a multidimensional construct which incorporated the constantly changing relationship between the individual and the environment. These researchers divided stress-coping into three different components. They suggested that in order to understand the effect of a particular life stress on the individual it was necessary to consider (a) the social situation, (b) personality variables, and (c) the perception and appraisal of events. Moos and Billings (1982) expanded on this theory and developed a model of coping with stress which consisted of three domains and nine responses. The three domains included (a) appraisal-focused coping with stress, referring to cognitive evaluation; (b) problem-focused coping, dealing with advice and information-seeking, and (c) emotion-focused coping. The term "role strains" has been used to define the link between the social environment and the interpersonal aspects of an individual (Dohrenwend & Shrout, 1985).

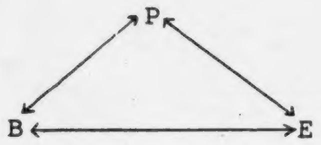
However, consideration of life stress and illness is further complicated by yet another dimension. This is the susceptibility of the individual to protective and risk factors. These include both interpersonal and external aspects. Interpersonal factors embody genetic predisposition, such as health status, and personal characteristics such as intellect and emotional stability. Individuals with good personal strengths and good health status may cope with life problems more efficiently than the individual who may be vulnerable because of poor health (Rabkin & Struening, 1976).

Bandura (1978) critiqued the interactional models of stress. He commented that although an attempt was made to include both situational and dispositional factors, there was still no real insight into the nature of the interaction. He stated that existentialists emphasized the individual's capacity for free choice and he preferred the term "reciprocal determinism" to incorporate "...the production of effects by events, rather than in the doctrinal sense, that actions are completely determined by a prior sequence of causes, independent of the individual" (p.

343). Bandura, a social learning theorist, believed that external events influenced behavior with the help of cognitive processes. The individual must decide whether or not to attend to specific portions of the environment. Cognitive processes also determined what value was placed on a particular event. Bandura postulated three different schematic views of interaction. In his models, "B" represented behavior, "P", the cognitive and internal events that effect perception and behavior, and "E" represented the external environment.

1. Unidirectional. B = (P,E) In this model the individual and environment are independent variables that combine to produce behaviors. The relationship between "P" and "E" is not known.
2. Partially bi-directional. B = (P ⟷ E). In this model the person and situation mutually influence each other. However, behavior is considered to be an outcome of this interaction, but is not involved in a causal way with the interaction.

3. Interactional Model.



This model is more abstract, but more truly interactional in that a more dynamic relationship is implied. There is an interaction between environmental, interpersonal, and behavioral influences, but no directionality is implied (Bandura, 1978).

Summary of TMD Literature

The relationship between stress and illness is indeed very complex. Simple unicausal models as postulated by early theorists cannot adequately express the relationship between the quality and quantity of life events and the individual perception or experience of stress. This partially accounts for the variability and lack of consistency in research related to the influence of stress in the production of illness. Many models imply a unidirectional flow of influences from the individual to the final outcome. Rather, a true interactive approach involves an assumption of reciprocity. The eventual outcome in terms of stress is determined by the circular flow involving interpersonal events, environment, and behaviors with no particular directionality being employed.

Recent research emphasizes the importance of considering all aspects of the individual's life from genetic and biological, to psychological and psychosocial. It may never be possible to assign a primary role to any particular factors, but rather a holistic attitude must prevail reflecting the complex nature of human interaction with the environment.

III. METHODOLOGY

The present study is part of a larger research project on diagnosis and treatment of TM dysfunction in adolescence, which is being conducted by the Tempromandibular Joint Investigative Unit (TMJ Unit) at the University of Alberta. The TMJ Unit recognizes the heterogenity of TMD and is comprized of a multidisciplinary team including two Orthodontists, a Prostodontist, two Oral Surgeons, a Psychologist, a Physiotherapist, and a Radiologist. The TMJ Units' philosophy emphasizes an integrated approach to dealing with TMD and cranio-facial pain focusing on the inter-relationship of physical, psychological, and psychosocial factors associated with the etiology of these conditions.

The basic research design is quasi-experimental and is a tripartite field study employing data gathered by confidential questionnaires, as well as psychological assessments and a clinical examination. The sample was self-selected, composed of adolescent patients referred for assessment of possible TM disorder.

This chapter will discuss the following topics: (a) sample description, (b) research procedure, (c) instrumentation, (d) data collection, and (e) data analysis.

Description of Subjects

The subjects of the study were a group of 70 adolescents aged 11 to 17 years. It had originally been intended to limit the age range to 12 to 16 years, however, shortage of subjects referred made it necessary to broaden the age range by two years. Subjects were referred from dental and medical offices in Edmonton and surrounding area with 90% of the study sample, coming from dental offices. Letters were distributed to practitioners explaining the research protocol and requesting volunteer help for the study. The criteria used for subject selection included adolescents presenting with headache or facial pain, with or without obvious features of TMD (Appendix A & B). Exclusion criteria were symptoms related to other specific or general causes. Subjects who participated were given a clinical examination at no cost, and filled out the study questionnaires. Those adolescents who were found to require treatment were referred to a further research study on treatment of TMD in adolescents. It had been explained to all participants that refusal to take part in the study would not effect further treatment. In fact, no subject refused to participate.

Study Procedure

If the referring dentist or physician felt that an adolescent was suitable to participate in the study initial contact was made by a referral letter to the TMJ Unit. This was followed by a telephone call from the TMJ Unit to arrange appointments. At the time of initial interview both the adolescent and accompanying parent/guardian were asked to sign consent forms (Appendix C & D). Each subject was given a coded identification number to ensure confidentiality. The nature of the research was explained to parents and subjects. Each subject was then interviewed by a dental specialist who completed a standardized history and clinical examination. Each subject then completed four self-report questionnaires. The total time taken to complete all the assessment instruments varied between 45 and 90 minutes. The accompanying parent or guardian was also asked to complete a 15 minute intake questionnaire. This included socio-demographic information, family, and medical background. A research assistant was available throughout the entire testing period to assist in any difficulties understanding or reading the assessment instruments.

Instrumentation

The purpose of the study was to ascertain any psychosocial correlates of TMD. It was also intended to determine the relationship between stressful life events, TMJ dysfunction in adolescents, and mediating factors that could make the adolescent more or less vulnerable to develop somatic symptoms.

Six sets of measures were used to gather information:

(1) Adolescent Intake Questionnaire,
(2) Parent Questionnaire,
(3) Basic Personality Inventory (BPI),
(4) the Multidimensional Assessment of Stressful Life Events,
(5) the Intellectual Achievement Responsibility Scale (IAR), and
(6) the Craniomandibular Index (CMI).

1. Adolescent Intake Questionnaire

This 16-page questionnaire was developed specifically for the study (Appendix E). It included 232 items inquiring about a broad range of general and specific problems which explore the multi-dimensional and complex nature of TMD. This questionnaire was designed to ascertain which variables might be contributing factors or psychosocial correlates of the disorder and is exploratory in nature, and therefore many of the subscales will require further validation.

In order to reduce the number of variables on this questionnaire the following subscales were derived by summing across specific items.

(a) **Headache.** - This subscale consisted of five items and was designed to measure the presence, frequency, duration, level, and functional effect of the headache pain.

(b) **Jaw/Facial Pain.** - This subscale consisted of five items measuring the presence, frequency, duration, and functional effect of jaw and facial pain.

(c) **Illness Complaints.** - Information regarding illness complaints was elicited on a 96-item scale to determine any patterns of illness behavior and somatization. This subscale was made up of items looking at number of symptoms, medications, clinical tests, health care use, and number of illnesses and treatments.

(d) **Self-Perception.** - Nine items were included in this subscale looking at self-perception regarding general health, intellectual ability, music, physical skills, hobbies, and social skills.

(e) **Parafunctional Habits.** - Nine items were included in this subscale to measure maladaptive parafunctional habits and activities.

(f) **Social Support.** - This subscale consisted of 20 items designed to measure aspects of perceived social support from friends and family.

(g) **Family Pain Problem (FPP).** - This subscale consisted of seven items and was included to explore whether certain families had a propensity to develop somatic symptoms in response to heightened stress.

(h) **Multiple Pain Problem (MPP).** - Seven items were included in this subscale to determine the number of pain sites that an individual was experiencing. This subscale was derived from items used by Dr. S. Dworkin in his research on the epidemiology of pain complaints in the Seattle region and was used with his permission (Dworkin, 1990).

(i) **Tension.** - This subscale contained eight items measuring subjective symptoms of anxiety and tension, as measured by muscle spasms of the head, neck, jaw, shoulders, back, stomach, arms, and legs.

(j) **Symptom Severity Index (SSI).** - This subscale consisted of a checklist of 58 symptoms and five visual analogue scales. The Visual Analogue Scales (VAS) were used to ascertain the sensory, affective, and severity levels of pain. Despite its uni-dimensional limitations the VAS has been widely used in pain research (LeResche, Burgess & Dworkin, 1988; Melzack, 1983). The VAS included in this subscale measured (a) frequency (FR), (b) duration (DI), (c) intolerability (TO), (d) severity (SI), and (e) unpleasantness (AI). The SSI has been shown to be a reliable and sensitive indicator of the general level of pain and to have a positive correlation with the CMI ($r = .46$, $p < .01$)

(Fricton & Schiffman, 1986). The SSI is calculated by adding together the scores on the five scales, the number of physical symptoms and dividing them by 60, as follows:

SSI = FR+DI+SI+AI+TO+# of symptoms/60

2. Parent Questionnaire

This instrument was developed to collect socio-demographic information on the family and the adolescent. It included past medical history, age and sex of family members, and socio-economic status (see Appendix F).

3. Basic Personality Inventory

The Basic Personality Inventory (BPI) (Douglas N. Jackson, 1974) was used in the present study because of its relatively short and easily understood format (Appendix G). This is a Canadian designed self-report questionnaire that can be administered to anyone with at least a Grade 5 reading level. It has gender specific adolescent norms, both male and female, drawn from two Canadian provinces. It was designed to identify emotional maladjustment as well as personal strengths, and yields significant information regarding personality functioning. The raw scores are converted to T-scores which have a mean range of 50 and a standard deviation of 10, thus enabling ease of interpretation and comparisons of scales. The BPI has good validity and reliability and is commonly used in both adult and adolescent populations in pain perception research. This inventory has been shown to have good psychometric properties.

The BPI is a 240-item self-administered questionnaire measuring personality and psychopathology. It uses a true-false format and takes between 20 and 40 minutes to complete. It is based on a construct approach rather than an empirically derived class or group model, as in the MMPI. There are twelve subscales as follows: (a) Hypochondriasis, which measures preoccupation with physical complaints and tendency to somatize; (b) Anxiety, which measures self-control in everyday and crisis situations; (c) Depression, reflecting sadness, hopelessness, and disinterest in life; (d) Thinking Disorder, which measures disorganization of thought and distractibility and the ability to differentiate daydreams from reality; (e) Denial, reflecting the individual's contact with his or her feelings; (f) Impulse Expression, which measures the individual's ability to think beyond the moment; (g) Interpersonal Problems, which refers to the ability for relationship with others and ability to tolerate criticism; (h) Social Introversion, which is the ability to relate to others in social spheres and the need for the company of others; (i) Alienation, which measures the individual's removal from societal values and involvement in delinquent subcultures; (j) Self-depreciation describes personal self-degradation and dissatisfaction with self, especially personality characteristics and achievements; (k) Persecutory Ideation, reflecting the extent to which an individual trusts others and accepts personal responsibility rather than blaming; and (l) Deviation, reflecting unusual or bizarre behaviors. Each scale consists of 20 items.

Reddon, Holden and Jackson (1983) reported on a comparison between the BPI, the California Psychological Inventory (CPI), and the MMPI on three groups: (a) normal adults, (b) adults with psychiatric problems, and (c) high school students. Correlations between samples on all three tests were found to be in the .70 to .90 range. Test reliability was also investigated by Holden, Fekken and Jackson (1985). They found that test-retest coefficients on the 12 scales ranged from .63 to .87 over one month intervals.

A further study by Helmes and Barilko (1985) also attested to the superiority of the BPI over the MMPI in defining psychopathology. The BPI has also been found to be a more sensitive instrument than the MMPI in differentiating pain patients from controls (Jackson, 1974; Jackson & Messick, 1971).

Jaffe, Leschied, Sas, Austin and Smiley (1985) reported on a study aimed at developing an objective method of recognizing behavioral problems and predicting recidivism in a Young Offender population. They tested 148 girls and 453 boys referred to a Family Court Clinic. These authors identified seven profile types found in the assessment of young offenders. This included those with significant mental maladjustment who scored high in Depression, Anxiety, Self-depreciation, and Deviation. These young offenders appeared to have depression related to familial difficulties of long-standing, and responded well to therapy. They also differentiated a further group who had interpersonal adjustment problems and showed a sensitivity to criticism, anti-authoritarianism, and impulsiveness. A further sub-group defined by this study were those who somatized their anxiety. They tended to show higher scores on Hypochondriasis, Anxiety, and Social Introversion scales. These young offenders were often socially isolated and used illness to avoid dealing with their emotional problems.

The BPI can therefore, be considered a useful test of basic personality characteristics, psychopathology, and psychosocial coping in adolescents. However, for the purpose of this study the Deviation, Persecutory Ideation, and Thinking Disorder scales were not used as they were not considered relevant to a basically healthy population.

4. The Multi-dimensional Assessment of Stressful Life Events Scale

The Multi-dimensional Assessment of Stressful Life Events Scale was developed in 1981 by Newcomb, Huba and Bentler (Appendix H). This is a 43-item self-administered questionnaire pertaining to specific activities and life experiences common to adolescence. The instrument is easy to administer and takes approximately 10 minutes to complete. The scale was normed on 1,000 adolescents aged 12 to 17 years in the United States. It produces information regarding stressful life events at two points in time; (a) more than one year ago, and (b) one year or less. A major consideration when deciding to use this scale was its ability to yield a measure of the desirability and the adolescent's cognitive appraisal of the life event. The instrument has seven mutually exclusive clusters, as follows: (a) Family/parents, (b) Accident/illness, (c) Sexuality, (d) Autonomy, (e) Deviance, (f) Relocation, and (g) Distress. Research indicates that there are no sex differences in total number of life events. However, females are more likely to endorse more concerns regarding Illness or Distress, while males will score higher on Deviance.

5. The Intellectual Achievement Responsibility Scale

The Intellectual Achievement Responsibility Scale (IAR) (Crandall & Greenway, 1978; Crandall, Katkowsky & Crandall, 1965) is a test designed to measure internal-external locus of control in school-aged children (Appendix I). It is based on Rotter's social learning theory, and uses a cognitive behavioral framework. The IAR is specific for intellectual and academic performance. Good internal locus of control, that is a perception that one is in control of one's actions and their outcome is correlated positively with greater persistence, better utilization of available cues, and better hypothesis formation. Internal locus of control is positively associated with better information acquisition, school performance, interpersonal effectiveness, and mental and physical health (Crandall & Greenway, 1978).

Most internal-external locus of control scales (Rotter, 1966) considered locus of control on a general basis and often did not specify the situational component. The present test differs from other locus of control measures in that it differentiates between perception of responsibility for successes or failures, and confines its inquiry to the child's feelings about significant others in their environment including friends, teachers, and parents. The IAR consists of 34 forced-choice items. The items deal only with external experiences concerning interactions with parents, teachers, or peers. Since the IAR deals with actual objective external situations only, it appears more meaningful for adolescents than other measures which also include items related to chance, luck, and fate as external environmental forces. In the IAR each item describes either a positive or negative achievement and asks the child to respond as to whether the situation occurring is within his or her own control, or alternatively is outside their control.

Since personal beliefs determine many social behaviors and attitudes, locus of control may reflect a personality characteristic that influences how an individual may perceive events that happen to them and their perception of self-success and self-esteem (Rotter, 1966). Studies on locus of control have shown that individuals who tend to have external locus of control have lower self-esteem, higher anxiety levels, and are more vulnerable to stress (Saranson, Levine, Basham & Saranson, 1983). In TMD it has also been found that individuals with external locus of control have higher disease conviction (Marbach et al, 1988). Folkman (1984) suggested that locus of control was a significant mediator of stress and illness and could determine differential coping patterns to life stress. Research suggested that individuals with high internal locus of control had a cognitive sense of their own responsibility and control over life events, and were often more able to take appropriate action to cope with adversity.

The IAR was initially normed in 1962 on 923 children and adolescents between grades 3 and 12. More recent normative data was gathered in 1975 and 1976. This sample consisted of 735 children from the same five school systems examined in the previous study.

The IAR yielded three scores: (a) I total, a total internal locus of control score indicating self-responsibility for success and failure; (b) an I+ score reflecting the number of positive events each individual assumed responsibility for; and (c) an I- score reflecting the number of negative events for which an individual accepts blame. Test-retest reliability for the IAR at two months ranged from 0.66 to 0.74 (p = .001). Split-half reliability for both I+ and I- was 0.54, and 0.57 respectively (n = 130). The mean score for boys grades 6 to 12 ranged between 23.4 (s.d. 3.9) and 24.1 (s.d. 4.4) for the total "I" score, and between 24.2 (s.d. 4.2) and 25.3 (s.d. 3.8) for girls grades 6 to 12.

6. Craniomandibular Index

Epidemiological studies on TMD have resulted in a wide range of results. It is apparent that TMD may represent a spectrum of disorders of the TM joint and masticatory muscles. Methodological problems in accurately identifying TMD have led to equivocal and often contradictory results in many studies. Faced with this problem, Fricton and Schiffman (1986) proposed a standardized clinical examination for measuring tempormandibular symptomatology called the Craniomandibular Index (CMI) (see Appendix J). This instrument yields three sets of scores as follows:

1. Dysfunction Index (DI) which measures joint tenderness, pain during joint movement, TMJ noise, range of motion, and deviation in movement. The DI consists of 26 items.
2. Palpation Index (PI) which measures muscle tenderness in all the muscles of mastication. It consists of 36 items.
3. The Craniomandibular Index (CMI) is calculated by adding the Dysfunction Index (DI) and the Palpation Index (PI) and dividing by two. The CMI yields a score from 0 to 1. However, for ease of interpretation the decimal place was rescaled for all the values by a factor of 100. (e.g., a score of .3 would be rescaled at 30.0).

The CMI was designed as a standardized measure of severity of TMD to be used in clinical and epidemiological studies. It provides clinical information to enhance the history provided by the patient and to rule out other conditions. Items on the CMI were derived from clinical examination on large numbers of TMD patients. Objective criteria are defined for each item. Research indicates that the CMI demonstrates sound reliability (.80 to .90) and validity. Positive correlations between the CMI and the Helkimos Dysfunction Index (a widely used TMD research index) are as follows: r = 0.641 (CMI), r = 0.65 (DI), and r = 0.52 (PI). Inter-rater reliability demonstrated positive results for the three CMI scales with inter-rater and intra-rater reliabilities ranging between .84 and .96, (Fricton & Schiffman, 1986).

7. Inter-rater Reliability

In the present study in order to reduce error and variability in clinical examination inter-rater reliability was evaluated on seven cases for the two oral surgeons administering the CMI. A pilot study on three cases was initiated to determine specific criteria for the clinical procedure.

Data Analysis

The data from the study was analyzed descriptively and comparitively utilizing the following statistical methods:

1. The descriptive statistics of the sample consists of means, standard deviations, and frequency counts for the independent and dependent variables.
2. Pearson product moment correlations were calculated to answer questions concerning relationships between TMD and the major psychosocial variables in the study.
3. Composite subscales were calculated for many of the variables in the parent and adolescent questionnaires in order to ascertain the reliability of these subscales. Item analysis was performed and Cronbach's alpha coefficient were calculated.
4. A series of analyses was carried out to look at gender and age differences across the independent and dependent measures. Analysis of variance (ANOVA) and cross-tabulations using the chi-square statistic were conducted to ascertain significant differences.
5. In order to examine personality characteristics subjects were grouped according to their profiles on the BPI, and subsequently classified into three groups. Analysis was limited to these three groups and analysis of

variance (ANOVA) was conducted to ascertain whether there were statistically significant differences on the Craniomandibular Index, Palpation and Dysfunction Index, and Symptom Severity Index.

6. In order to determine whether it was possible to identify subgroups of TMD an analysis was carried out to see whether individuals differentially clustered on the CMI scales (Dysfunction Index and Palpation Index). The clustering was accomplished by dividing the subjects into four groups based on the median scores on the TMD measures. Once these groups were determined an analysis of variance (ANOVA) was performed using the above variables as dependent measures.
7. A subsequent grouping was carried out on the TMD scales (CMI, PI, DI and SSI). Subjects were grouped on each of these four subscales into a three level classification as follows: (a) Group 1, ½ s.d. below the mean; (b) Group 2, ± ½ s.d. at the mean, and (c) Group 3, > ½ s.d. above the mean.

Analysis of variance was carried out on these groupings for comparison with the psychosocial variables. Tukey's Range Test was performed where group differences were evident.

8. To differentiate between internal derangement (Dysfunction Index, DI), and myofascial pain dysfunction (Palpation Index, PI), and remove any overlap between the two groups, so that part of the PI, which may represent a more somatic component could be considered, a part correlation was carried out between the DI and PI, and the BPI.
9. Because of the large number of variables in the study, and in order to reduce the complexity of the hypothesized model, exploratory analysis was carried out. Principle component analysis was conducted to provide a clearer picture of the inter-relationship amongst the variables (Tinsley & Tinsley, 1987).
10. One of the problems associated with the diagnosis and treatment of TMD has been poor agreement among clinicians as to what constitutes TMD. The multi-dimensional aspect of TMD dictates that the ability to dependably measure those signs and symptoms is necessary

for research. In this study inter-rater reliability is defined as "...the degree of consistency among examiners when making observations of the same clinical variable" (Dworkin, LeResche & DeRouen, 1987, p. 1). Inter-rater reliability was calculated in this study on seven cases in the following manner:

$$RC = \sigma^2 t - \sigma^2 r \text{ X } C$$

where $\sigma^2 t$ = the total variance, $\sigma^2 r \times C$ = the variance due to rater times cases (Bartko, 1976).

11. A post hoc power analysis was carried out on some of the major variables tested in the conceptual model. This procedure was considered appropriate to determine what sample size would be required to possibly detect a difference when the null hypothesis appeared false. The probability of detecting these differences was also calculated (Cohen, 1977, p. 359-362). Sample size can determine the power of a particular test, and the larger the effect size (ES), the smaller the sample size reqjuired to determine differences. Cohen (1977) had established a standardized effect size and operational criteria for using levels

of effect size in research decision making. A 0.1 effect size is considered small, 0.25 is considered a medium effect, and 0.40, a large effect. Cohen (1977) suggested that an arbitrary number of 0.80 be used as a criteria for the power necessary to draw conclusions.

In keeping with the exploratory focus of the study the acceptable significance level for statistical analysis was set at .05. The above statistics were calculated using the University of Alberta Division and Educational Research Services Statistical Package for the Social Sciences (SPSS-X, 1988).

Hypotheses

The following major hypotheses were generated from the literature:

1. There will be no significant differences between the items on the Craniomandibular Index as measured by two clinical raters.
2. There are significant differences across the Dependent Variables (Craniomandibular Index, Palpation Index, Dysfunction Index, Symptom

Severity Index and Psychosocial Measures) for males and females suffering from TMD.

3. There are significant differences across the Dependent Variables (Craniomandibular Index, Palpation Index, Dysfunction Index, Symptom Severity Index and Psychosocial Measures) for early (11-14 year old) and late (15-17 year old) adolescents with TMD.
4. There are significant differences on the Dependent Variables (Basic Personality Inventory, Stress Questionnaire, Intellectual Achievement Response, Subscales on the Adolescent and Parent Questionnaires) between adolescents with high levels of TM musculature problems (Palpation Index) and those with high levels of dysfunction problems (DI).
5. Elevated T-scores (≥ 70) on the Depression, Anxiety, Hypochondriasis and Denial scales on the Basic Personality Inventory will be associated with increased scores on the Craniomandibular Index, in particular, the Palpation Index.
6. There will be a significant relationship between high stress, elevated Basic Personality

Inventory scores, and high levels on the Craniomandibular Index.

7. Adolescents with TMD will show significantly increased numbers of life events prior to the onset of TMD.
8. There will be a significant relationship between high stress, high locus of control, and low levels of Craniomandibular Index scores.
9. There will be a significant relationship between high stress, high social support, and low levels on the Craniomandibular Index.
10. There is a significant relationship between parafunctional habits, stress, muscle tension, and the Palpation Index subscale of the Craniomandibular Index.
11. It is possible to identify a model delineating the inter-relationship between the psychosocial correlates of TMD in adolescents.
12. There will be high item reliability across the thirteen subscales of the Parent and Adolescent Questionnaires.

IV. RESULTS

The main purpose of this study was to (a) ascertain the psychological and psychosocial correlates of TMD, (b) to attempt to identify subgroups of TMD based on psychological findings, and (c) to delineate an interactional psychosocial model to define variables identifying adolescents at risk for developing TMD. This chapter will present the results of the statistical analysis. The descriptive and socio-demographic information will be presented first, followed by an evaluation of the presented hypothesis based on the study results.

Descriptive Statistics

The total sample (n = 70) was made up of 61 females (87.1 %) and 9 males (12.9%). The subjects ranged in age from 11 to 17 years with a mean age of 14.6 years and a standard deviation of 1.5. The mean grade level of the subjects was 9.6, with standard deviation of 1.6. Table 1 summarized the descriptive information for the sample.

Table 1

Characteristics of the Sample

			AGE			GRADE		
	n	Percent	S.D.	Mean	Range	S.D.	Mean	Range
Female	61	87.0	1.5	14.6	11-17	1.7	9.5	6-12
Male	9	13.0	.83	14.8	14-16	1.7	10.0	9-11
Total Sample	70	100.0	1.5	14.6	11-17	1.6	9.6	6-12

TMD had been present for less than one year in 17 subjects (25.8%), for one to two years in 29 subjects (37.9%), and for more than two years in 24 subjects (36.3%). Prior to the study, 29 cases had previous treatment, including splints (n = 17, 24.3%), physiotherapy, (n = 1, 1.4%), medication (n = 7, 10%), braces/retainers (n = 3, 4.3%), and biofeedback (n = 1, 1.4%). Following inclusion in the study, 53 cases (75.7%) were deemed to be in need of treatment. Thirty-one cases were prescribed dental splints (44%), nine cases received biofeedback treatment (12.9%), four cases were prescribed medication (5.7%), one subject received ultrasound (1.4%), two received splint adjustment (2.9%), and six cases received physiotherapy (8.6%). Those subjects not in need of treatment were referred back to their physicain or dentist.

Adolescent Questionnaire;

Table 2 presented the percentages and frequencies of the type and nature of TMD symptoms derived from the adolescent questionnaire. The onset of TMD was either associated with problems chewing (31.4%), or could not be associated with any particular precipitating event in 44.3% of cases. Fifty-nine subjects (84.3%) reported that chewing aggravated the pain and 48 subjects reported that the pain was relieved by lying down (68.6%). Sixty-five subjects (93.4%) reported that they suffered from headaches for the previous six months or more, while 61 subjects (87.1%) reported facial pain over the previous six months. It appeared that the majority of subjects suffered from pain on a daily basis. Thirty-seven subjects (52.9%) had pain on both sides of their face. However, only two subjects (8.6%) reported that the pain interfered significantly with their lives and six subjects indicated that they were absent from school because of pain on a weekly basis.

Table 2

Adolescent Questionnaire. Nature and Type of Pain.

Percentages and Frequencies for the Total Sample (n=70)

	Percentage	Frequency
Onset Associated with Precipitating Factors		
Jaw Surgery	0	0
Blow to Face or Jaw	12.9	9
Motor Vehicle Accident	4.3	3
Recent Dental work	8.6	6
Chewing	31.4	22
Tooth Extraction	2.9	2
Orthodontics	4.3	3
Stressful Situation	17.1	12
Unknown	44.3	31
Aggravating Factors		
Bright Lights	38.6	27
Chewing	84.3	59
Stress	51.4	36
Riding in a Car	41.3	10

Table 2 (Cont'd)

Adolescent Questionnaire. Nature and Type of Pain.

Percentages and Frequencies for the Total Sample (n=70)

	Percentage	Frequency
Loud Noise	35.7	25
Touching Area	18.6	13
Yawning	58.6	41
Fatigue	27.1	19
Food/Drink	28.6	20
Weather Changes	25.7	18
Socializing	8.6	6
Walking	18.6	13
Talking	38.6	27
Vigorous Exercise	30.0	21
Early Morning Hours	34.3	24
Relieving Factors		
Heat	27.1	19
Massage	52.9	37
Distraction	22.9	16
Mild Activity	21.4	15
Cold	15.7	11
Sleep	60.0	42
Lying Down	68.6	48
Exercise	13.0	9
Solitude	32.9	23

Table 2 (Cont'd)

Adolescent Questionnaire. Nature and Type of Pain.

Percentages and Frequencies for the Total Sample (n=70)

	Percentage	Frequency
Frequency of Jaw/Facial Pain		
Constant	30.0	21
One Episode per Hour	7.1	5
One Episode per Day	41.4	29
One Episode per Month	20.0	14
No Pain	1.4	1
Associated Pain		
Headaches > 6 Months	93.4	65
Facial Pain < 6 Months	87.9	61
Absences from School		
At Least Once a Month	24.0	17
At Least Once a Week	8.6	6
Location of Jaw/Facial Pain		
Left Side	14.3	10
Right Side	21.4	15
Both Sides	52.9	37
No Pain	11.4	8

Parent Questionnaire

The results of the Parent Questionnaire reported that 78% of the adolescents came from two-parent families, while 18% were single parent families. The remaining 4% lived in other family arrangements including joint custody and foster placements. The mean income for the families was $30,000 to $50,000 (38%). Eleven percent of the families earned less than $15,000. In general parents reported their teenagers were not absent from school because of the TMD and only missed one to two days per year. Twenty-eight cases (46.3%) had a previous history of migraine or cluster headaches, but only four cases (6.6%) were reported as having had previous psychological counselling.

Inter-rater Reliability

"Hypothesis 1: There will be no significant differences between the items on the Craniomandibular Index as measured by two clinical raters".

One of the problems associated with the diagnosis and treatment of TMD had been poor agreement amongst clinicians as to what constituted this disorder. The multidimensional aspects of TMD dictated that the ability to dependably measure the signs and symptoms was a necessity for research. Inter-rater reliability was calculated in this study on seven randomly selected cases. The statistical summary of findings is reported in Table 3.

Inspection of Table 3 revealed that the overall reliability for the CMI was .71, with the DI and PI respectively showing reliabilities of r = .88 and r = .60. However, it was apparent that the negative values for the TMJ Capsule Palpation and Neck Palpation scales would no doubt effect the overall reliability. Examination of the scores across these two variables for both raters revealed a wide variability. Reliabilities were re-analyzed, deleting these two subscales (18 items). Subsequently the reliability for the DI increased to r = .99, the PI to r = .66, and the overall CMI to r = .81. Unfortunately, logistic difficulties made it impossible to carry out the reliability study on more than seven cases so that the results of this analysis must be treated with caution. However, despite the small sample size, it can be confirmed that strong inter-rater reliability of the CMI is evident, and hypothesis number one can be confirmed.

Table 3

Inter-Rater Reliability

	Alpha Coefficient	
Mandibular Movement (MM)	.53	
TMJ Noise (TN)	.92	
TMJ Capsule Palpation (TP)	-.34	
Dysfunction Index (DI)	.88	*(.99)
Extra-Oral Jaw Muscle Palpation (EP)	.76	
Intra-Oral Jaw Muscle Palpation (JP)	.66	
Neck Muscle Palpation (NP)	-.25	
Palpation Index (PI)	.60	*(.66)
Craniomandibular Index (CMI)	.71	*(.95)

*Reliability calculated without the TP and NP Subscales

Gender;

"Hypothesis 2: There are no significant differences across the Dependent Variables (Craniomandibular Index, Palpation Index, Dysfunction Index, Symptom Severity Index and Psychosocial Measures) for males and females suffering from TMD".

The sample consisted of 61 females and nine males. Because of the unequal sample size, one strategy that was deemed acceptable to analyze gender differences was to randomly sample from the 61 females, and compare a subset of eight males and eight females. Analysis of variance (ANOVA) did not reveal significant mean differences for males and females across the measures. Cross-tabulation between gender and type of onset of TMD using the chi-square statistic showed that levels of TMD were not affected by gender. In terms of psychosocial measures, the female means were not significantly different than the male means.

It was appreciated that because of the small sample size and lack of power, differences may exist that could not be detected. Another concern regarding multiple univariate analysis was due to the possibility of type 1 errors where significant differences could be due to chance because of the small sample size and the large number of variables measured. However, because of the overall small sample size and the large number of variables studied, multivariate analysis was not warranted (Haase & Ellis, 1987).

Age

"Hypothesis 3: There are significant differences across the Dependent Variables (Craniomandibular Index, Palpation Index, Dysfunction Index, Symptom Severity Index and Psychosocial Measures) for early (11-14 year old) and late (15-17 year old) adolescents with TMD".

In order to identify possible age differences across the variables, subjects were divided into two groups. Group 1 consisted of the early adolescents aged 11-14 years (n = 35) and Group 2 consisted of late adolescents aged 15-17 years (n = 35). Analysis of Variance (ANOVA) was carried out and revealed significant mean differences for age on seven of the psychosocial variables. Table 4 summarized the results of the ANOVA.

Table 4

Analysis of Variance for Age, Group 1 (11-14 years) (n =35), Group 2 (15-17 years) (n = 35)

Variable	SSB	DF	MSB	SSW	DF	MSW	F	P
Alienation	325.7	1	325.7	4094.5	68	60.2	5.4	.02
Social Introversion	389.0	1	388.9	6190.0	68	91.0	4.3	.04
Habits	56.7	1	56.7	460.6	68	6.8	8.4	.00
Stress-*Past	84.7	1	84.7	1299.3	68	14.1	4.4	.03
Stress-*Perception	15841.1	1	1584.1	16708.7	68	249.3	6.3	.01
Stress-*Present	108.1	1	108.1	1212.5	68	17.8	6.1	.01
Autonomy^2	16.5	1	16.5	164.6	68	2.4	6.8	.01

* Autonomy^2	Stress events that happened within the last year.
* Past	Number of events over 1 year ago.
* Perception	Perception of life events as negative.
* Present	Number of events within the last year.

Although there were no significant differences found for gender and age across the TMD scales it was apparent that younger males (11-14 years) scored higher on the Palpation Index subscale ($\overline{x}$ = 21.0), while older males (15 to 17 years) scored much lower overall on both the Papation Index and Dysfunction Index subscales ($\overline{x}$ = 3.2 and $\overline{x}$ = 7.8 respectively).

Overall, results of the analysis did not reveal any statistically significant differences between gender and age scores on any of the TMD scales. Therefore, hypothesis 2 and 3 could not be tested.

TMD Scales

"Hypothesis 4: There are significant differences on the Dependent Variables (Basic Personality Inventory, Stress Questionnaire, Intellectual Achievement Response Scale, subscales on the Adolescent and Parent Questionnaires) between adolescents with high levels of TM musculature problems (Palpation Index) and those with high levels of dysfunction problems (DI)".

In order to determine whether subgroups of TMD could be identified the following procedures were carried out:

1. An analysis was carried out to ascertain if individuals clustered differentially on the CMI scale (DI and PI). This was accomplished by dividing the study sample into four groups based on their median scores. Group 1 consisted of those individuals who scored high on the DI and low on the PI (n = 11). Group 2 was made up of subjects who scored high on the PI and low on the DI (n = 9). Group 3 consisted of subjects who scored low on both measures (n = 22), and Group 4 were those individuals who scored high on both measures (n = 27). An analysis of variance (ANOVA) was performed with the above variables as dependant measures. Significant group differences were found on only two of the psychosocial variables. Table 5 summarized the results of the ANOVA. Significant group differences were found for Multiple Pain Problems and Jaw Pain ($p < .05$).

Tukey's range tests were performed to examine the significance of the differences between the means for each of the significant variables and to determine the direction of these differences. On the Multiple Pain Problem subscale Group 4 ($\overline{x} = 4.6$) scored significantly higher than Group 3 ($\overline{x} = 2.9$). On the Jaw Pain subscales there were also significant differences between Group 4 ($\overline{x} = 71.1$) and Group 3 ($\overline{x} = 38.3$), and Group 3 ($\overline{x} = 38.3$) and Group 1 ($\overline{x} = 69.5$). Table 6 presented the Tukey's Comparison Tests and indicated that the means for the four TMD subscales (DI, PI, CMI and SSI) were significantly different across the four groups ($p < .05$).

Table 5

TMD Scales (CMI, PI, DI and SSI)

Analysis of Variance for Group 1, 2, 3 and 4

Variable	SSB	DF	MSB	SSW	DF	MSW	F	P
Multiple Pain Problems	36.4	3	12.1	194.0	65	3.0	4.1	.01
Jaw Pain	16175.7	3	5392.0	61297.3	65	943.0	5.7	.00
DI	6886.0	3	2295.3	3443.3	65	53.0	43.3	.00
PI	12982.3	3	4327.4	9695.7	65	149.1	29.0	.00
CMI	8416.7	3	2805.6	3504.3	65	53.9	52.0	.00
SSI	5417.5	3	1805.9	15161.4	65	236.9	7.6	.00

Group 1 - High DI Low PI
Group 2 - Low DI High PI
Group 3 - Low DI Low PI
Group 4 - High DI High PI

Table 6

Tukey's Comparison of Mean for the TMD Scales

(Group 1,2,3 and 4) (n = 69)

	Group 1 n = 11	Group 2 n = 9	Group 3 n = 22	Group 4 n = 27	
DI	24.8	10.5	9.3	31.1	
PI	5.3	26.7	3.0	32.4	
CMI	14.7	17.9	5.9	31.8	
SSI	52.1	38.6	35.0	54.4	
Multiple Pain Problems	4.0	3.8	2.9	4.6	*GR 3-Gr 4
Jaw Pain	69.5	44.3	38.3	71.1	*GR 3-Gr 4, GR 3-Gr 1

* Significant at $P < .05$

Although mean differences across the four TMD groups were found in only two of the psychosocial variables, Table 7 indicated the overall trend. Although not reaching significance it appeared that Group 4 (high DI and high PI) had higher means on the Hypochondriasis (60.9) and Depression (50.5) scales on the BPI. On the other hand Group 2 (high PI) had more Past Stress (9.0), Parafunctional Habits (5.7), and Headaches (76.7).

Table 7

Psychosocial Measures

Means and Standard Deviations for TMD Groups 1, 2, 3 and 4

(n = 69)

	Group 1 n = 11	Group 2 n = 9	Group 3 n = 22	Group 4 n = 27
Hypochondriasis	54.0 (7.5)	57.1 (10.5)	54.9 (11.8)	60.9 (11.8)
Depression	47.0 (6.9)	48.7 (9.5)	47.3 (8.3)	50.5 (12.9)
Parafunctional Habits	3.5 (3.1)	5.7 (2.8)	4.5 (2.4)	5.4 (2.3)
Number of Illnesses	5.6 (5.4)	7.7 (4.6)	6.0 (5.6)	6.9 (5.0)
Past Stress	6.8 (4.4)	9.0 (5.2)	8.9 (4.6)	8.4 (4.2)
Headache	57.3 (32.7)	76.7 (23.8)	52.3 (25.4)	69.0 (29.4)

Table 8 presented the range of scores, means, and standard deviations for the total sample across the four TMD scales.

Table 8

TMD Scales (CMI, PI, DI and SSI)

Means and Standard Deviations for Gender and Age

	Total Sample n = 70	M1 n = 4	M2 n = 5	F1 n = 31	F2 n = 30
DI	20.2(12.3)	19.5(15.0)	13.6(6.9)	21.0(13.0)	20.7(12.1)
PI	17.9(18.2)	25.2(22.8)	3.2(7.1)	20.3(19.1)	17.0(16.6)
CMI	18.7(13.2)	21.0(12.0)	7.8(6.3)	20.3(14.5)	18.6(12.4)
SSI	45.5(17.4)	48.7(31.0)	32.4(38.9)	47.5(16.0)	45.2(16.4)

M1 = Males age 11 - 14 years
M2 = Males age 15-17 years
F1 = Females age 11 - 14 years
F2 = Females age 15-17 years

2. Subsequent groupings were carried out on the four TMD scales (CMI, DI, PI, SSI). Each of the four subscales was classified into three groups as follows: Group 1, subjects who scored ½ standard deviation below the mean; Group 2, subjects who scored ± ½ standard deviation within the mean; Group 3, subjects who scored ½ standard deviation above the mean.

This classification system was then applied to the CMI, PI, DI, and SSI. This grouping was carried out in order to achieve (a) a homogeneous samples across the three groups, (b) for comparison with the psychosocial scales, and (c) to classify the study sample into mild, moderate, and severe levels of TMD dysfunction. This grouping differed from the previous one in which study subjects were grouped simultaneously on Dysfunction Index and Palpation Index. Here the grouping depended on the level of the individual subscale, irrespective of the other measures. Table 9 summarized the range of scores, percentages, and numbers of males and females within each of the groups.

Table 9

TMD Scales. Range, Percentages and Frequencies For Group 1, 2 and 3

	Palpation Index (PI) (n=70)			Dysfunction Index (DI) (n=70)		
	Gr. 1 n = 28	Gr. 2 n = 26	Gr. 3 n = 16	Gr. 1 n = 32	Gr. 2 n = 20	Gr. 3 n = 18
Range	1-10	11-28	29+	0-15	16-27	28+
Percent	40.6	37.7	21.7	45.8	28.5	25.7
Males	5	3	1	5	3	1
Females	23	24	14	27	17	17

Table 9 (Cont'd)

TMD Scales. Range, Percentages and Frequencies

For Group 1, 2 and 3

	Craniomandibular Index (CMI) (n=70)			Symptom Severity Index (SSI) (n=69)*		
	Gr. 1 n = 28	Gr. 2 n = 25	Gr. 3 n = 17	Gr. 1 n = 26	Gr. 2 n = 22	Gr. 3 n = 21
Range	0-14	15-26	27+	0-39	40-55	56+
Percent	40.0	35.7	24.3	37.7	31.9	30.4
Males	5	2	2	6	0	3
Females	23	23	15	20	22	18

Group 1 = ½ S.D. below the mean
Group 2 = ± ½ S.D. within the mean
Group 3 = ½ S.D. above the mean

NOTE*: One subject did not complete the SSI.

On examination of the three groups of subjects based on their Dysfunction Index, analysis of Variance (ANOVA) indicated significant differences for Intellectual Achievement Response (I-Total), Jaw Pain, and Multiple Pain Problems. Table 10 summarized the results of the ANOVA for the Dysfunction Index (DI). Table 11 indicated the Tukey's Comparison and pointed out that adolescents with higher internal locus of control had lower levels of joint dysfunction (DI). As one would have expected, as Jaw Pain and Multiple Pain Problems increased, DI scores also increased.

Table 10

Analysis of Variance (ANOVA) for the Dysfunction Index (DI)

For Group 1, 2 and 3

Variable	SSB	DF	MSB	SSW	DF	MSW	F	P
I Total	120.9	2	60.4	798.6	50	15.9	3.8	.02
Jaw Pain	15988.1	2	7994.0	61845.2	67	923.1	8.7	.00
Multiple Pain Problems	41.1	2	20.6	193.5	67	2.9	7.1	.00

Table 11

Tukey's Comparison of Means for the Dysfunction Index (DI)

For Group 1, 2 and 3

	Group 1	Group 2	Group 3	
I Total	26.7	24.9	23.0	*Gr 1-Gr 3
Jaw Pain	41.1	65.9	75.9	*Gr 1-Gr 3, Gr 1-Gr 2
Multiple Pain Problems	3.3	3.9	5.9	*Gr 1-Gr 3

Gr 1 = ½ S.D. below the mean.
Gr 2 = ± ½ S.D. within the mean.
Gr 3 = ½ S.D. above the mean.

*Significant at $p < .05$

Analysis of the three groups based on the Palpation Index Subscale, revealed significant differences on Multiple Pain Problems. Table 12 summarized the analysis of variance (ANOVA). Tukey's Comparison revealed that individuals with lower levels of PI also reported fewer Multiple Pain Problems, and significant differences were evident between Group 1 and Group 3 ($\overline{X}$ = 3.2 and $\overline{X}$ = 4.9, respectively) ($p < .05$).

Table 12

Analysis of Variance (ANOVA) for the Palpation Index (PI) For Group 1, 2 and 3

Variable	SSB	DF	MSB	SSW	DF	MSW	F	P
Multiple Pain Problem	29.7	2	14.8	200.6	66	3.04	4.9	.01

Table 13 presented the results of the ANOVA for the CMI scale. On this measure group differences were evident for the Multiple Pain Problems measure. Tukey's tests suggested signifcant differences between Group 1 and Group 2, and Group 1 and Group 3. The means for Multiple Pain Problems in the three groups were as follows: (a) Group 1, $\overline{X}$ = 3.6, (b) Group 2, $\overline{X}$ = 4.2, and (c) Group 3, $\overline{X}$ = 5.1. ($p < .05$).

Table 13

Analysis of Variance (ANOVA) for the Craniomandibular Index (CMI)

For Group 1, 2 and 3

Variable	SSB	DF	MSB	SSW	DF	MSW	F	P
Multiple Pain Problem	45.4	2	22.7	189.2	67	2.8	8.0	.00

Gr 1 = ½ S.D. below the mean.
Gr 2 = ± ½ S.D. within the mean.
Gr 3 = ½ S.D. above the mean.

Table 14 summarized the results of the ANOVA across the groups on the Symptom Severity Index (SSI). On this analysis significant differences were found on six variables. As expected, as the level of subjective pain increased so did the scores on each of the significant variables. Table 15 indicated the results of Tukey's range test of comparison of means for the SSI subscale for groups 1,2 and 3. Overall, results indicated that Hypothesis 4 could be confirmed for multiple pain problems, I Total and Jaw Pain.

Table 14

Analysis of Variance (ANOVA) for the Symptom Severity Index (SSI)

For Group 1, 2 and 3

Variable	SSB	DF	MSB	SSW	DF	MSW	F	P
Hypochondriasis	1485.9	2	743.0	7191.3	66	109.0	6.8	.00
Tension	85.2	2	42.6	800.3	66	12.1	3.5	.03
Illness Complaint	3391.3	2	1695.6	19903.5	66	301.6	5.6	.00
Headache	5237.0	2	4618.4	46130.3	66	699.0	6.6	.00
Jaw Pain	20735.0	2	10367.6	57094.6	66	865.1	12.0	.00
Multiple Pain Problems	49.0	2	24.5	185.6	66	2.8	8.7	.00

Gr 1 = ½ S.D. below the mean.
Gr 2 = ± ½ S.D. within the mean.
Gr 3 = ½ S.D. above the mean.

Table 15

Tukey's Comparison of Means for the Symptom Severity Index (SSI)

For Group 1, 2 and 3

	Group 1	Group 2	Group 3	
Hypochondriasis	52.8	56.7	64.0	*Gr 3-Gr 1
Tension	1.6	3.1	4.3	*Gr 2-Gr 1
Illness Complaints	27.7	38.5	44.4	*Gr 3-Gr 1
Headache	48.7	71.4	73.6	*Gr 3-Gr 1, *Gr 2-Gr 1
Jaw Pain	38.0	57.7	80.2	*Gr 3-Gr 2
Multiple Pain Problems	2.9	4.3	4.6	*Gr 1-Gr 3, *Gr 2-Gr 1

* Significant of p < .05

3. In order to determine whether the Palpation Index (PI) subscale represented a more somatic component of the CMI a part correlation was carried out between the Palpation Index, Dysfunction Index, and the Basic Personality Inventory. A regression procedure of DI, PI, and the residuals was calculated. These residuals were then correlated with the BPI scales. The part correlations for the Palpation Index and the BPI scales were all non-significant, with the exception of Social Introversion, which was statistically significant ($r = 0.22$, $p < 0.03$).

Overall results of these statistical analyses on the TMD scales suggested that subgroups could not be identified on the basis of Personality Characteristic, Social Support, Stress, or Internal Achievment Response. It appeared that high scores on CMI and DI could predict differences in Multiple Pain Problems and Jaw Pain, while high levels of PI were only associated with Multiple Pain Problems.

Personality Characteristics

"Hypothesis 5: Elevated T-scores (≥ 70) on the Depression, Anxiety, Hypochondriasis and Denial scales on the Basic Personality Inventory will be associated with increased scores on the Craniomandibular Index, in particular, the Palpation Index".

In considering personality characteristics and their relationships to TMD subjects with T-scores equal or greater than 70 on the BPI were identified. These individuals were subsequently assigned to three groups (not mutually exclusive) as follows:

Group 1 consisted of individuals with at least one elevated T-score (≥ 70); n = 25

Group 2 consisted of subjects with at least one elevated T-score (≥ 70) on the Personal Emotional Adjustment Cluster (Depression, Anxiety, Hypochondriasis); n = 14

Group 3 classification was the same as group two with the addition of the Denial subscale (n = 19);

Analysis of Variance (ANOVA) was conducted to ascertain whether there were mean differences on the CMI, PI, DI and SSI. Table 16 presented the means and standard deviations for the total sample across the

Basic Personality Inventory subscales. Table 16 also indicated the frequency and percentage of subjects with elevated T-scores (≥ 70) across the twelve BPI scales. Inspection of Table 16 revealed that overall, the mean scores for the sample across the twelve subscales were within the norm. Forty-five subjects (64.3%) did not have any elevated T-scores (≥ 70). Twenty subjects (28.6%) had one elevated score, three subjects (4.3%) had two elevated scores, and two subjects (2.8%) had four and six elevated scales respectively, suggesting signficant emotional dysfunction. Hypochondriasis was the most frequently elevated subscale (n = 8) and Anxiety came a close second (n = 6)

Table 16

Basic Personality Inventory, Means and Standard Deviation (n=70).

Frequencies and Percentages of Subjects with

Elevated T-Scores (≥70)

Variable	Average	S.D.	Frequency	Percentage (T-Score ≥ 70)
Hypochondriasis	57.4	11.2	8	11.5
Depression	48.7	10.2	4	5.7
Denial	50.0	10.4	5	7.1
Interpersonal Problems	47.5	10.7	2	2.9
Alienation	43.9	8.0	0	0
Persecutory Ideas	47.0	9.0	1	1.4
Anxiety	50.8	11.8	6	8.6
Thinking Disorder	45.9	10.0	2	2.9
Impulse Expression	45.9	8.6	0	0
Social Introversion	51.0	9.7	4	5.7
Self Depreciation	47.0	9.1	2	2.9
Deviation	48.0	9.2	2	2.9

Results of the ANOVA across the three BPI groupings suggested significant mean differences for Group 1 and Group 3 on the PI and CMI scales. Tables 17 and 18 summarized the results of the ANOVAs. Group 1 consisted of 25 subjects (35.7%) whose mean score on the PI was 25.5 (s.d. 22.6). This compared to the remainder of the sample (n = 45) whose mean PI scores were 13.7 (s.d. = 13.8). Similarly, the means for Group 1 were also significant for the CMI subscales, with a mean of 23 (s.d. 15.7) as compared to 16.4 (s.d. 11.2, n = 45).

Table 17

Basic Personality Inventory.

Analysis of Variance (ANOVA) for Group 1

Variable	SSB	DF	MSB	SSW	DF	MSW	F	P
PI	2210.5	1	2210.0	20467.4	67	305.5	7.2	.00
CMI	681.9	1	681.9	11485.9	68	168.9	4.1	.04

Table 18

Basic Personality Inventory

Analysis of Variance (ANOVA) for Group 3

Variable	SSB	DF	MSB	SSW	DF	MSW	F	P
PI	2187.6	1	2187.6	20490.2	67	305.8	7.2	.00
CMI	660.4	1	660.4	11512.4	68	169.3	3.9	.05

Group I -Subjects with at least one elevated T-score (≥ 70)

Group 3 -Subjects with at least one elevated T-score (≥ 70) on the Depression, Anxiety, Hypochondriasis and Denial Scales

Group 3 consisted of nineteen subjects (27.1%) with significant differences on the PI (27.1, s.d. 20.6) compared to the remainder of the sample who had a mean of 14.5 (s.d. 16.2, n = 51). Likewise there were signficant differences on the CMI in Group 3 with a mean of 23.8 (s.d. 14.1) compared to 16.9 (s.d. 12.6, n = 51) for the remainder of the sample.

Fourteen subjects (20%) were in Group 2, and no mean differences were evident.

Results of the ANOVA support the hypothesis that subjects could be differentiated on the Palpation Index and Craniomandibular Index based on elevated T-scores on the BPI.

Relationships amongst the Variables

Pearson product moment correlation coefficients were calculated in order to evaluate the hypothesized relationships amongst the psychosocial variables and the dependant measures. As the direction of the correlations were predicted one-tailed tests were employed and significance levels were set at 0.05. Only those correlations that reached statistical significance (above .30) were considered to be of theoretical importance. Table 19 depicted the correlation matrix for the total sample.

Table 19

Pearson Correlation Coefficients

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Intellectual Achievement Response																									
1) I Total																									
Basic Personality Inventory (BPI)																									
2) Hypochondriasis												0.34	0.62		0.31	0.43	0.32	0.46	0.34	0.42					
3) Depression		0.38									-0.40								0.39	0.41					
4) Denial										0.70									-0.37						
5) Interpersonal Problems			0.31								-0.32														
6) Alienation			0.48	-0.31	0.46					0.41				0.34					0.30						
7) Anxiety		0.40	0.48	-0.37	0.31	0.30				0.39									0.35	0.39					
8) Impulse Expression			0.30	-0.51	0.33	0.47													0.40						
9) Social Introversion			0.49							0.56															
10) Self Depreciation			0.70			0.41	0.39																		

NOTE: All correlations shown in the table were significant $p < .05$

Table 19

Pearson Correlation Coefficients

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Adolescent & Parent Questionnaires																									
11) Total Support			-0.40	0.37	-0.32	-0.36																			
12) Parafunctional Habits		0.34														0.33									
13) Multiple Pain Problems		0.62												0.38	0.34	0.48	0.56	0.33				0.41			
14) Family Pain Problems						0.34							0.38									0.30			
15) Tension		0.31											0.34			0.33		0.32							
16) Headache Pain		0.43										0.33	0.49		0.33		0.40	0.41							
17) Jaw Pain		0.32											0.57			0.40						0.44			
18) Illness Complaints		0.46											0.33		0.32	0.42			0.37	0.53					
Multidimensional Stress Questionnaire																									
19) Past Stress (>1 Yr. Ago)		0.34	0.39	-0.37		0.30	0.35	0.39										0.37		0.63					
20) Present Stress		0.42	0.41	-0.37			0.39	0.39		0.30								0.53	0.63		0.81				

NOTE: All correlations shown in the table were significant $p < .05$

Table 19

Pearson Correlation Coefficients

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Multidimensional Stress Questionnaire																									
21) Perception of Events/ Unhappiness											0.34							0.46	0.81	0.76					
TMD Scales																									
22) Dysfunction Index (DI)													0.41	0.30			0.44					0.45		0.79	0.44
23) Palpation Index (PI)		0.33											0.33		0.31	0.31	0.31							0.89	0.36
24) Craniomandibular Index (CMI)		0.30											0.42				0.42					0.79			0.47
25) Symptom Severity Index (SSI)		0.41											0.51			0.43	0.60	0.34						0.36	

NOTE: All correlations shown in the table were significant $p < .05$

Although none of the correlations could be considered "robust" there were modest relationships between certain variables. There were associations between the BPI scales which ranged from .30 to .70 with negative relationships between Denial and Alienation (r = -.31), and Denial and Impulse Expression (r = -.51).

"Hypothesis 6: There will be a relationship between high stress, elevated Basic Personality Inventory scores, and high levels on the Craniomandibular Index".

On examination of the TMD scales the Dysfunction Index (DI) was positively correlated with Multiple Pain Problems (r = .41), Family Pain Problems (r = .30), Jaw Pain (r = .44), Palpation Index (r = .45), Craniomandibular Index (r = .79), and the Symptom Severity Index (r = .44).

The Palpation Index (PI) was positively related to Hypochondriasis (r = .33), Multiple Pain Problems (r = .33), Tension (r = .31), Jaw Pain (r = .31), CMI (r = .89), and the SSI
(r = .36). Significant relationships were also observed between the CMI and Hypochondriasis (r = .30),

and Multiple Pain Problems (r = .42). The CMI was also associated with the SSI (r = .47). It appeared that the DI and PI were both strongly associated with the CMI as one would expect, whereas only modest relationships were observed between these variables and the SSI.

Overall, Hypochondriasis was the only BPI scale significantly related to the TMD scales. It was surprising that the Anxiety and Depression scales did not reach significance. The three measures of stress and the seven stress subscales were not significantly correlated with any of the TMD scales.

"Hypothesis 7: Adolescents with TMD will show increased numbers of life events prior to the onset of TMD".

On examination of the stress scales, significant correlations were noted between Past Stress and Hypochondriasis (r = .34), Depression (r = .39), Denial (r = - .37), Alienation (r = .30), and Illness Complaints (r = .37). A similar pattern was observed for Present Stress and correlations between Hypochondriasis (r = .42), Depression (r = .41), Denial (r = - .37), and Impulse Expression (r = .39). Present

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Stress had a stronger association with Illness Complaints (r = .53) and as one would expect, with Past Stress (r = .63) and Perception of Events (r = .81).

In general on the Multidimensional Assessment of Stressful Life Events Scale the mean score for number of stressful events within the past year was 8.6 (s.d. 4.4), and 8.4 (s.d. 4.5) for number of events that happended more than one year ago. On examination of the seven clusters of this scale it appeared that most events were reported for the Autonomy, Family, and Sexuality clusters. The least events were reported for Deviance, Accident/Illness, and Relocation. These mean differences amongst the stress clusters did not reach statistical signficance.

"Hypothesis 8: There will be a relationship between high stress, high locus of control, and low levels of Craniomandibular Index scores".

On the Intellectual Achievement Response Scale (IAR) no significant correlations were observed across the measures. It had been anticipated that the IAR would be negatively correlated with the Stress measures, Social Support and TMD scales. Overall, the mean score for the IAR (I - Total) was 24.9

(s.d. 4.1), 11.9 (s.d. 2.6) and 13.0 (s.d. 2.5) for the I- and I+ respectively.

"Hypothesis 9: There will be a relationship between high stress, high social support, and low levels on the Craniomandibular Index".

No significant correlations were observed between any of the Social Support Scales (Total Support, Family Support and Friends' Support) and the other measures. The exception was the Denial subscale which correlated with Total Support (r = .37).

"Hypothesis 10: There will be a relationship between parafunctional habits, stress, muscle tension, and the Palpation Index subscale of the Craniomandibular Index".

Parafunctional Habits was associated with the hypochondriasis subscale of the BPI (r = .34) and Tension (r = .33), and not with the TMD scales or stress measures as expected.

In summary, the results of the correlational analysis did not support the expected patterns based on hypothesis 4, 6, 8, 9 and 10.

Principal Component Analysis

"Hypothesis 11: It will be possible to identify a model delineating the inter-relatedness of the psychosocial correlates of TMD in adolescents".

A principal component analysis was used to arrive at a clearer picture of the possible interrelationships amongst the variables. The procedure was applied to the hypothesized model of TMD in adolescents and consisted of four main constructs as follows:

1. A Stress Factor (precipitating event) which included the Multidimensional Assessment of Stressful Life Events, Parafunctional Habits, and the Tension subscale;
2. A Risk factor which was made up of the BPI subscales, and Illness Complaints;
3. A Protective Factor which consisted of the IAR and the three Social Support Scales;
4. An Outcome Factor which included the TMD scales (DI, PI and SSI).

The factor scores from the first principal component were derived and these four new weighted variables were then correlated with each other. This correlation was undertaken in an attempt to ascertain the relationships between the different components of the hypothesized model. Table 20 summarized the results of this analysis. It was intended to analyze this model using a Path Analysis Technique, however, the degree of relationships between the variables was not of sufficient magnitude to warrant continuing with this approach (Anderson, 1987; Fassinger, 1987). The results of this exploratory data analysis indicated that the hypothesized model for psychosocial correlates of TMD could not be confirmed in the present study.

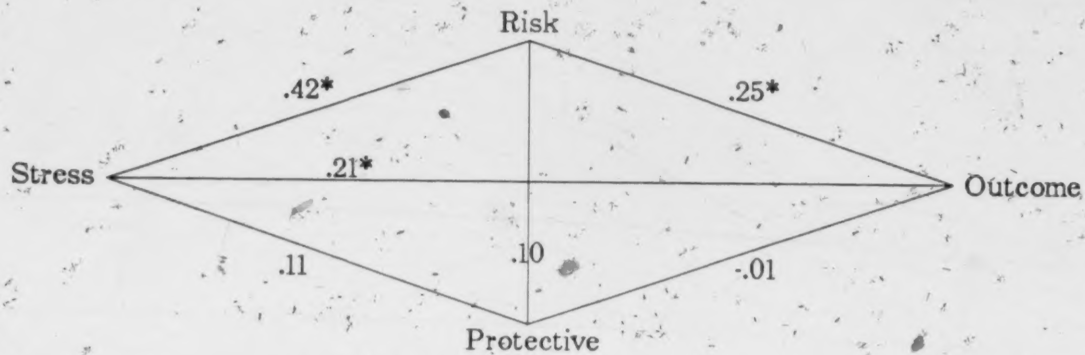
Table 20

Pearson Correlations Between the Four Factors In the Hypothesized Model

Variable	Stress	Risk	Protective	Outcome
Stress Factor		.42*	.11	.21*
Risk Factor			.10	.25*
Protective Factor				-.01
Outcome				

* Significant at $p < .05$.

Hypothesized Model


Risk
.42*
.25*
Stress
.21*
Outcome
.11
.10
-.01
Protective

Reliability of the Subscales on the Parent and Adolescent Questionnaires

"Hypothesis 12: There will be high item reliability across the thirteen subscales of the Parent and Adolescent Questionnaires".

Cronbach's alpha coefficients were calculated on the major subscales of the Parent and Adolescent Questionnaires. Table 21 summarized the results which ranged from 0.38 to 0.94. Overall nine scales were considered to be within acceptable range (.70 or above). However, the correlations for Family Pain Problems were weak, and Parafunctional Habits, Multiple Pain Problems, and Self-perception were within the moderate range. On inspection of these subscales one might not have expected a consistent response pattern. For example, the Family Pain Problems subscale, while measuring pain items, looked at different pain sites (head, legs, back and so on). It may have been more appropriate with this type of scale to apply test-retest reliability as an alternative method of reliability, or the scales could have been re-developed to include more items pertaining to each specific symptoms. Overall, with the exception of the Family Pain Problems subscale, hypotheses 8 was confirmed.

Table 21

Cronbach Alpha Reliabilities for the Subscales on the Parent and Adolescent Questionnaires

Subscale	Number of Items	Alpha Coefficient
Family Support	10	.75
Friends Support	10	.83
Total Support	20	.84
Parafunctional Habits	9	.52
Multiple Pain Problems	7	.65
Family Pain Problems	7	.38
Self-Perception	8	.85
Habits	8	.61
Number of Illnesses	40	.77
Number of Tests	16	.90
Number of Professionals Seen	22	.94
Number of Treatments	22	.94
Illness Complaints	96	.71

Post Hoc Power Analysis

Results of the power analysis are shown in Tables 22 and 23. The power analysis was carried out on a four group analysis of variance (ANOVA), and a two group analysis of variance (ANOVA). The first ANOVA grouping was based on levels of TMD as measured by the Craniomandibular Index (CMI). Subjects were grouped according to levels of TM musculature problems (Palpation Index) and levels of jaw dysfunction (Dysfunction Index) (Hypothesis 4, p. 154).

The second power analysis was carried out on a two group ANOVA based on age (Group 1, 11 to 14 years; Group 2, 15 to 17 years) (Hypothesis 3, p. 152). Tables 22 and 23 indicated the results of the post hoc power analysis. Cohen (1977) stated that a difference of .1 indicated a small effect, .25 a medium effect, and .40 a large effect. Power analysis suggested that many of the observed effects which were reported as being non-significant may have indeed been found to be significant if adequate sample sizes were available. For example, it can be seen that a medium effect was found in the present study for hypochondriasis, parafunctional habits, and headache, and that somewhat larger sample sizes of 42, 37, and 29 respectively would have been sufficient to obtain a power of .80 and enhance the possibility of significant results. However, on the variables of present and past stress, 438 and 112 subjects would have been required respectively to adequately test the hypothesis. Similarly, as can be seen from Table 23, very large numbers of subjects would be necessary to ascertain the influence of age differences and TMD, and tests of these hypotheses may not be practical.

Table 22

Power Analysis For Four Group Analysis of Variance (ANOVA)

Variable	F Prob	F Ratio	F	SS.80	Power	D.F.	n
Hypondriasis	.20	1.60	.26*	42	.40	3	17
Depression	.68	.50	.15	123	.15		
Interpersonal Problems	.63	.59	.16	112	.17		
Denial	.91	.18	.09	438	.08		
Social Introversion	.31	1.21	.23	55	.32		
Self-Depreciaiton	.55	.71	.18	91	.20		
Anxiety	.79	.35	.12	214	.11		
Impulse Expression	.96	.11	.07	767	.07		
Parafunctional Habits	.15	1.84	.28*	37	.45		
Number of Illnesses	.76	.40	.13	183	.13		
Illness Complaints	.61	.60	.16	112	.17		
Social Support	.28	1.29	.24	50	.34		
Present Stress	.90	.20	.09	438	.08		
Past Stress	.61	.60	.16	112	.17		
Headache	.10	2.1	.31*	29	.54		

Table 22 (Cont'd)

Power Analysis For Four Group Analysis of Variance (ANOVA)

Variable	F Prob	F Ratio	F	SS.80	Power	D.F.	n
Intellectual Achievement Response	.51	.76	.18	91	.20	3	17

NOTE:

SS.80 Sample size required to detect a significant difference. Criteria .80

Power Probability of Detecting a Difference

F Effect Size $\frac{\sigma m}{\sigma}$ $\frac{\text{weighted S.D. among group means}}{\text{within group S.D.}}$

n $\frac{N}{K}$ $\frac{\text{Total Sample Size}}{\text{Number of Groups}}$

Table 23

Power Analysis For Two Group Analysis of Variance (ANOVA)

Variable	F Prob	F Ratio	F	SS.80	Power	D.F.	n
Dysfunction Index	.51	.70	.05	1571	.06	1	35
Palpation Index	1.79	.18	.16	160	.14	1	35
Craniomandibular Index	1.14	.29	.13	262	.11	1	35
Symptom Severity Index	1.05	.31	.12	306	.10	1	35

NOTE:

SS.80 Sample size required to detect a significant difference. Criteria .80

Power Probability of Detecting a Difference

F Effect Size $\frac{\sigma m}{\sigma}$ $\frac{\text{weighted S.D. among group means}}{\text{within group S.D.}}$

n $\frac{N}{K}$ $\frac{\text{Total Sample Size}}{\text{Number of Groups}}$

Summary

In summary, the overall results of this investigation suggested that two groups of TMD disorder in adolescents could be differentiated, based on BPI scores, multiple pain complaints and jaw pain. There were no significant age or gender differences for TMD. Significant associations with either past or present life stress were not found. Nor were there significant associations between locus of control, perceived family or peer support, and TMD. There was no evidence for the interactional model of TMD based on the criteria measured. Post hoc power analysis indicated that an overall sample size of at least 120 subjects would be required to provide a meaningful test of the hypotheses that were non-significant.

V. DISCUSSION

The purpose of this study was to investigate the relationship of psychosocial variables and TMD in adolescents and to attempt to delineate an integrated model for the development of TMD. The main objectives were to (a) understand the psychological precursors of TMD, (b) identify those adolescents at risk to develop TMD and, (c) identify subgroups of TMD sufferers. This chapter will discuss the results of the study both in theoretical and practical terms. As previously stated, it was intended that this study would add to the literature on TMD in adolescence, and provide diagnostic suggestions to assist in defining this condition. Finally, this chapter will discuss the limitations of the study and propose possible avenues for future research.

Many of the adult studies on TMD suffer from lack of clarity in defining their criteria for TMD or in the objectivity of their clinical findings. To avoid this pitfall a well established clinical assessment instrument with good reliability and validity, the Craniomandibular Index (CMI), was used for the study (Fricton & Schiffman, 1986). To ensure reliability between the two clinicians who performed the physical examinations in the present study inter-rater reliability was examined. A random sample of seven adolescents was chosen and assigned blindly to both clinicians. Overall inter-rater reliability for the CMI was 0.71. For the two subscales, the Dysfunction Index (DI) and the Palpation Index (PI), reliabilities were 0.88 and 0.60 respectively. However, negative correlations were found between two components; TMJ capsule Palpation (TP) and Neck muscle Palpation (NP). Without these two components the CMI demonstrated stronger reliability with the CMI coefficient of r = 0.95, DI r = 0.99, and PI r = 0.66. These results compared favorably with Fricton & Schiffman (1986), who reported overall CMI inter-rater reliability as r = 0.95, DI r = 0. 87, and PI r = 0.84. These findings indicate that the CMI could be accepted as a reliable and reproducible indicator of clinical symptoms and severity of TMD. The negative correlations of TP and NP point out the difficulty in this kind of clinical assessment even with trained clinicians. It may have been that these two measures could be omitted from the CMI without altering its reliability and consistency. Dworkin et al (1990) and Stockstill, Gross and McCall (1989) suggested that in clinical procedures such as measurement of muscle tension or tenderness, when applied pressure may differ from examiner to examiner, a training method must be found to calibrate pressure so as to exclude individual variation.

There were 70 subjects in the study: 61 females and 9 males. Their ages ranged between 11 and 17 years with a mean age of 14.6 years. The majority of subjects came from two parent families in the middle to upper income range. In this respect the sample was similar to adult TMD clinic patients, being largely female and in the middle and upper income ranges.

Pain was the primary symptom reported, although 77% of subjects reported problems in jaw clenching, 55% had bruxism, and 31% had difficulty chewing. Ninety-three percent of subjects reported headaches in the previous six months and 87.1% reported facial pain in the same period. Most subjects reported daily pain, but did not relate it to any precipitating event. The pain seemed to have little influence on school attendance or social activities. Interestingly, 68.6% of the sample reported pain relief when lying down and 46% had a previous history of migraine or tension headaches. This was similar to adult studies which showed that in adult TMD patients headaches were present in 88.6% of women and 74% of men (Fricton et al, 1988). Given and Stack (1986) suggested that TMD might begin with headache complaints in childhood and adolescents and may eventually lead to joint derangement.

In 32% of the sample there was a history of trauma including previous motor vehicle accidents and whiplash injuries. However, there were no statistically significant relationships between onset of TMD, injury, or previous dental treatment. It should be noted that following assessment for this study, 53 subjects (76%) were deemed to need some form of physical treatment.

The results from the demographic and descriptive information concluded that the profile of the present sample of adolescent TMD clinic patient was very similar to that of the typical adult TMD patient. The adolescents differed from the adult patients in not reporting subjectively any previous life stresses associated with onset of TMD and that TMD did not appear to interfere significantly with their school or social lives.

Age and gender were also analyzed to determine whether these variables contributed to differences in TMD symptomatology. Overall, younger boys tended to score highest on the TMD scales. Older males reported the least TMD symptoms while older female adolescents reported more psychosocial problems. Females also scored higher on the major psychosocial variables in comparison to males. In particular, females reported higher scores on Hypochodriasis, Multiple Pain Problems, Headaches and Jaw Pains which appeared to increase with age. In older adolescents (15 to 17 years) seven psychosocial variables were significant. These were Social Introversion, Personal Habits (smoking, drinking), number of present and past Life Stresses, Perception of Life Events as negative, and stress events dealing with issues of Autonomy. This could be explained as a function of physical and psychosocial development. For example, in late adolescence the need to separate from the family and establish independence would account for the concern with autonomy. Male/female differences in self-reporting of TMD symptoms and psychological problems have been evident in numerous studies. It has been found that boys tended to report fewer symptoms than girls, and younger teenagers reported fewer psychosocial problems than older teens (Allgood-Merten & Lewinsohn, 1990; Ohno, Morinushi, Ohno & Ogura, 1988). Savedra, Tesler, Ward & Wegner (1988) pointed out that the association of pain with emotional problems was directly related to increased age and suggested a relationship between ability to recognize these associations and cognitive development. Raphael, Dohrenwend & Marbach (1990) found that female adolescents tended to see their lives as more stressful especially in terms of family and peer problems and suggested that female adolescents seemed to be more psychologically vulnerable than males, perhaps as a result of psychosocial expectations. Boys may be encouraged to be less analytical and more action-oriented than girls. Allgood-Merten and Lewinsohn (1990) pointed out that boys were reinforced for learning active instrumental behaviors and were encouraged to be resourceful and self-reliant. Girls often had no such reinforcement and tended to rely more on family and peers for support.

In the hypothesized interactional model for TMD, stress as reported by the Multidimensional Assessments of Stressful Life Events instrument, was considered the antecedent of TMD symptoms. If in fact this was so it would be expected that the study sample would have reported more life events occurring prior to the onset of TMD than in a normal population. However, no significant correlations were found between life events and TMD.

Significant relationships were found between stressful life events and the BPI scales. Past Stress correlated with Hypochodriasis (.34), Depression (.35), and Anxiety (.35). Present stressful life events showed modest correlations with Hypochondriasis (.42) and Depression (.42). Perception of negative life events correlated with Hypochodriasis (.35) and Anxiety (.30). These results were in agreement with Rabkin and Struening (1976) who found that life events as measured by the Holmes and Rahe scale accounted for only 9% to 16% of variance in physical conditions that had been presumed to be stress related. In adult TMD studies stressful life events had been reported to be significant factors in 50% to 70% of TMD disorders (Speculand & Goss, 1985). Nevertheless, the present study agreed with the results reported by Marbach et al (1988), who found no differences in life events between normal and TMD samples. These authors suggested that TMD patients had significantly fewer emotional supports and higher external locuses of control, showed abnormal illness behaviors, and were more preoccupied with illness symptoms than controls. This might account for the finding in the present study that older TMD adolescents reported higher Social Introversion, Hypochondriasis, Depression, and Anxiety. In examining the research on the BPI subscales a profile of mood and personal/emotional adjustment was described with elevated scores in Depression, Anxiety, Denial and Hypochodriasis (Jackson & Messick, 1971).

The failure to find significant associations between life events and TMD across the present sample might have been related to a number of factors. Life events may not have had the same significance to adolescents as adults. Indeed, Newcomb et al (1981) found that the most undesirable life events for adolescents were family stresses, especially death in the family, rather than environmental, economic, or work related stress as in adults. Many of the stresses experienced in adolescence were associated with developmental tasks and therefore, may have been considered normative and egosyntonic. Rubenstein, Heeren, Housman, Rubin and Stechler (1989) in their report on suicidal behavior in adolescence stated that suicidal adolescents had more family life stresses and isolation from peer support. They also proposed an integrated model for conceptualizing the response of teenagers to stressful life events. These researchers accentuated the importance of family cohesiveness and peer support as protective factors. They also commented that in adults negative life stressors were chronic, but that the developmental stresses of adolescents are acute. Rubenstein et al (1989) divided stress into two types: (a) External stress which related to environmental events such as perceived negative life changes, and (b) Internal stress which referred to temperamental and personality characteristics including cognitive skills and self-esteem that may determine individual sensitivity and coping ability. They considered depression to be a major internal risk factor. This indeed fits in with the conception of protective and vulnerability factors in children and adolescents which includes constitutional predisposition and family support (Rutter, 1986, 1987). The presence of depression as determined by the BPI in the present study, might have constituted a significant internal risk factor which brought about physical symptom production. Adolescents may have been more likely to respond to internal stresses related to temperamental characteristics and cognitive coping styles than external stressors.

Social Introversion as defined by elevated scores on the BPI often pertains to solitary individuals who may have poor support systems, are more vulnerable, and are more likely to react negatively to stress (Jackson, 1974). In fact social introversion was found to be a significant differentiating factor between the PI and DI groups. Social introversion may be related to anticipated problems in peer group interaction and socialization, and might in turn increase susceptibility to emotional problems.

The results of this study suggest that the presence of internal stress factors such as Hypochondriasis, Depression, Anxiety, and Social Introversion might make the individual at risk for the onset of TMD. It should be noted that the present sample could be expected to have low external risk factors, especially family issues such as divorce, as they came from relatively stable two parent families. Kashani et al (1981) concluded that life events alone were insufficient to account causally for onset of psychosomatic illness in children. Overall, the study sample scored in the normal range on the stress questionnaire. The number of life events was eight for both males and females. This finding was consistent with Newcomb et al (1986b) and Coddington (1972) who evaluated large groups of normal children and found the mean scores to be eight or nine events.

It had been hypothesized that adolescent TMD sufferers might be differentiated on the CMI subscales and psychosocial measures. Three statistical procedures were carried out to test this hypothesis.

In the first procedure the study sample was divided into four groups depending on their scores on the Dysfunction Index (DI) and Palpation Index (PI). Group 1 consisted of subjects who scored high on the DI and low on the PI, Group 2 (high PI and low PI), Group 3 (low on both measures), and Group 4 (high on both measures). Group 2 tended to score higher on Parafunctional Habits, Headaches, Number of Illnesses, and more Past Stress. Group 4 showed significant differences with regard to Jaw Pain and Multiple Pain Problems in comparison to the other groups. Although not reaching statistical significance, this group also had higher mean scores on psychosocial variables including Hypochodriasis, Depression, and Illness Complaints. A post hoc power analysis revealed that a greater number of subjects might have produced statistical results in consideration of the association between TMD and headaches, parafunctional habits, and hypochodriasis. However, in the case of stress and age differences, an inordinately large sample size would have been required to assess possible significance.

In the second procedure a part correlation was carried out to find if high PI scores constituted a different group of TMD, since there was considerable overlap between DI and PI scores. On this analysis Social Introversion on the BPI correlated ($r = 0.22$, $P < 0.03$) with the PI scores of the CMI. Marbach and Dworkin (1975) suggested that in TMD patients undergoing group psychotherapy there was a pattern of social isolation and depression. These findings suggested some association between PI and emotionally vulnerable teenagers. This also supported the previous results that adolescents with high PI and low DI may represent a different subgroup of TMD, and presented with more emotional problems and less jaw dysfunction than other TMD groups.

The third procedure was used to ascertain whether different subgroups could be identified based on the scores on the four TMD scales (CMI, DI, PI, and SSI). The sample was classified as mild, moderate, or severe depending on the TMD subscale scores. It was found that subjects in the severe range of overall CMI could be differentiated from moderate and mild CMI groups on multiple pain complaints. The severe DI group was significantly associated with Jaw Pain, I-total score and Multiple Pain Problems. The severe PI group was differentiated only on Multiple Pain Problems. It was also found that the severe SSI group was significantly associated with Hypochondriasis, Tension, Illness Complaints, Headaches, Jaw Pain, and Multiple Pain Problems. As the CMI scores increased so did the SSI. Scores on the SSI significantly differentiated the severe and mild CMI scorers. In particular the SSI appeared to be a sensitive measure of jaw pain and dysfunction, and a good screening instrument for measuring clinical severity of TMD.

In relation to multiple pain complaints, that is pain occurring at multiple body sites, Dworkin et al (1990) reported on associations between the number of pain complaints and elevated levels of somatization. They found that individuals with two or more pain complaints were at risk for developing major depressions and that the number of pain complaints was a predictor of major depression. In the present study 63% of the sample had four to five different pain complaints which suggested a high risk for depression and somatization.

If TMD was indeed related to emotional and personality problems, individuals with TMD would score in the pathological range on the BPI (Jackson, 1974). To satisfy rigorous research requirements a T-score of two standard deviations was considered necessary to report abnormality (70 or greater). In order to determine this the sample was divided into three groups depending on clusters of elevated scores on the BPI. On this analysis 25 subjects fell into Group 1 who had at least one elevated T-score (≥ 70) on the BPI. This group was significantly different than the rest of the sample with PI scores of 25.5 as compared to 13.7 in the remainder of the sample (n = 25 and n = 45 respectively). The only other group of significance was Group 3 which consisted of 19 adolescents. These subjects showed higher scores on Hypochondriasis, Anxiety, Depression, and Denial. In this case the PI score was 27.1 as compared with the rest of the sample which scored 14.5. As already noted, high BPI scores on Depression and Anxiety suggested problems in personal/emotional adjustment. The Hypochodriasis scale included physical complaints and may have been elevated in individuals with actual physical illnesses, but may also refer to individuals who are more comfortable expressing physical rather than psychological symptoms, and who tended to somatisize their distress. Individuals with high Denial scores were defensive or may prefer to avoid accepting stress induced affective responses (Jackson, 1974).

Belfer and Kaban (1982) reported that psychological factors were found in 25% of children with TMD and that TMD was associated with depression, anxiety, and school related problems, as well as psychiatric illness in the family. Eversole and Machado (1985) supported the present study in contending that there are indeed different types of TMD, some more physically based than others. They found that in myofacial pain and atypical pain groups there were elevated scores on the MMPI on Hypochodriasis, Depression, and Hysteria, and that these groups were statistically different from patients with jaw derangement. Fine (1971) also reported on the strong association between TMD patients and psychiatric symptomatology, but did not differentiate TMD with jaw derangement from myofacial pain disorders. Marbach and Lund (1981) pointed out that adult TMD patients had more depression and anxiety than other pain patients, and suggested that TMD problems were specifically related to depression. Depression was also related to amount of pain reported, number of previous consultations, and total number of symptoms. These authors did not define their TMD problems with any specificity and could have been describing chronic pain syndromes.

Parafunctional habits were expected to be related to stress and in turn, related to TMD. This was not confirmed in the present study, but parafunctional habits were associated with Hypochondriasis and Tension. However, Rugh and Lemke (1984) pointed out that parafunctional habits must be differentiated in terms of diurnal and nocturnal, and that nocturnal bruxism in adults can be related to stress as determined by EMG sleep studies. They also suggested that parafunctional habits in children may have a different relevance than in adults, and may represent normal developmental habits which are self-limiting. Wanman and Agerberg (1990) found that up to 15% of children exhibit bruxism and that 50% to 68% clench, but they do not consider this to be of etiological significance in TMD. In the present study there was no evidence that parafunctional habits directly related to TMD.

It had been expected that locus of control would have a significant relationship to TMD as represented by the score on the Intellectual Achievement Response measure (IAR). It had been anticipated that high IAR scores would correlate with low levels of TMD since it had been postulated that good internal locus of control would be a protective factor in preventing TMD. In fact no relationship, either positive or negative could be found between stress, TMD, and the IAR. Siddique and D'Arcy (1984) in a study of over 1,000 adolescents found that the protective role of locus of control was limited to school and peer group stresses. In the present study neither of these areas showed any untoward variation, which suggested that this sample were not experiencing major peer or school problems, so it is not surprising that the IAR failed to disclose anything.

It was anticipated that it would be possible to identify a model delineating the inter-relationship of the psychosocial correlates of TMD. This assumption was based on the conceptual understanding of TMD symptomatology in adults and the inter-relationship of life stress with various mediating factors. For the purposes of this study four factors were identified from the literature: (1) a Stress factor which consisted of life events, parafunctional habits, and subjective reports of tension; (2) a Risk factor which included the BPI subscales and Illness complaints; (3) a Protective factor which consisted of IAR and three social support scales; and finally (4) an Outcome factor made up of the four TMD scales (CMI, DI, PI, SSI).

Preliminary statistical analysis did not reveal strong associations between the various factors and in fact the data did not fit the hypothesized model. It may be that life stress theories of TMD based on adult studies may not apply in childhood and adolescence. Life stresses may in themselves not be sufficient to induce TMD without particular personality characteristics or susceptibilities. In fact adolescence may be "... a relatively peaceful and harmonious developmental phase" so that life events and developmental changes are not distressing to the adolescent (Siddique & D'Arcy, 1984, p 471).

The results of the study indicated that TMD in adolescents may indeed present as two different syndromes; one a more physical problem with high ratings in terms of jaw pain and joint problems, and the other a more psychologically based syndrome similar to the myofacial pain dysfunction described by Laskin (1969), or the multiple pain patient described by Dworkin et al (1990). There may still be considerable overlap in these two syndromes, especially in adult life when conservative dental treatment may have failed and TMD may merge into a complex spectrum of illnesses which include TMJ with joint derangement, and chronic pain syndromes with psychological features.

The results of this study have important diagnostic and treatment implications. It might be anticipated that in individuals with high Palpation scores and muscle tenderness, psychological factors are of primary importance in the etiology of their condition, and treatment might be started early with appropriate remediation including relaxation therapy, biofeedback treatment, psychotherapy, and chemotherapy for depression when appropriate. In those cases with high jaw dysfunction problems, while adjunctive psychological treatments may still be required to deal with pain, the primary treatment approach should be physical. Ohno et al (1988) in their study of TMJ in Japanese adolescents suggested that "...the junior high school period is the proper time to introduce preventative dental education and care." (Ohno et al, 1988, p 124).

There appeared to be a subgroup of adolescent TMD sufferers who might be considered a somatizing group and who present clinically with high muscle tenderness and tension with low joint dysfunction. This group may well represent a psychologically vulnerable group to suffer from psychosomatic illness and somatoform disorders who are also sensitive to depression. Early detection and appropriate treatment including management of any underlying psychological problems might bring about resolution and education on better methods of dealing with stress. This group is similar to the multiple pain complaint patients as described by Dworkin et al (1990) who may in fact be masking underlying emotional difficulties, especially depression, with their physical complaints. It may also be related to family patterns of expressing emotional difficulties in pain complaints. Raphael et al (1990) suggested that children of adult TMD patients may react to their parents' pain problems by themselves, expressing their emotional difficulties in physical complaints. The present study did not consider in detail parental histories of TMD, family patterns of coping with illness and pain, or the association between learned behavior and family pain complaints. This could form the basis for another study.

While both adolescent TMD groups were already showing differentiation with recent onset of TMD, it might be postulated that in some cases these syndromes might merge by adult life. In the high PI group continual muscle tension could lead to eventual joint derangement. The ensuing continual pain and discomfort would worsen associated emotional problems including depression and chronic pain syndromes. On the other hand, the high DI group might first present with a primarily physical condition, which if untreated could lead to a chronic pain syndrome and resulting psychological problems including depression and anxiety. This might also explain the problems in coming to definite answers about the etiology of TMD since we may in fact be dealing with two similar, but separate syndromes; one a variant of somatoform disorder associated with or secondary to psychological problems, and the other a physical problem with secondary psychological manifestations.

There are a number of limitations to the present study which must be considered when analyzing the study results. This was a selected sample in which all subjects were referred from dentists or physicians and caution was therefore, warranted in making generalizations from this sample. Presently, there is no normative data for the CMI in children and adolescents and administration of the CMI to a normal adolescent sample would be informative. Since the adolescents came mostly from two parent middle class families, who were not reporting any serious stressors, they may therefore be representing a biased sample. In adolescents the most significant life stressors seem to relate to family factors including separation or divorce (Minuchin et al, 1975; Rutter, Graham, Chadwick

& Yule, 1976). It may be worthwhile in future studies to look at children from different family structures and from all socio-economic backgrounds. A more in depth analysis of the family method of coping with pain and illness might shed further light on the association between pain behaviors and pain complaints.

In this preliminary exploratory analysis with adolescents, type I errors might have occurred due to the relatively small size of the sample and large number of variables measured. To avoid these methodological problems a larger sample might be used with fewer variables and a more equal male-to-female ratio. Many of the hypotheses generated from previous research and clinical findings were found to be statistically nonsignificant. In view of these negative findings, it is necessary to consider (1) variance in measurement, (2) non-homogeneity of the sample, and (3) small sample size, as differences may have existed and the possibility of type 2 errors may have been probable. This ambiguity could be avoided in future research by conducting a prior power analysis to ascertain sample sizes necessary to increase the probability of significance as "increases in sample size increases the power and the probability of detecting the phenomenon under test." (Cohen, 1977, p. 7).

In further studies of this nature it would be useful to utilize more than one stress measure and to better define stressful life events in adolescents. Rather than concentrating on external life stressors more psychological measures could be employed, particularly in relation to cognitive development and cognitive coping styles.

It would be necessary to repeat this study in one to two years to test the hypothesis that we are in fact dealing with different conditions, and to determine whether the high palpation (PI) group are early forms of internal joint derangement. It would also be informative to analyze the psychological and physical progression of the PI and DI groups over time.

An alternative model to explain the interrelationships of the psychosocial variables in adolescents with TMD might consider (1) precipitating factors in terms of internal stress (depression, anxiety, or hypochondriasis), or a physical predisposition to dysfunction of the tempromandibular system, (2) risk factors including family illness behavior, multiple pain complaints and social introversion, (3) protective factors which mediate against the onset of TMD might include family cohesion, and cognitive problem solving ability, (4) outcome could be considered under three possible headings. Those individuals with high muscle tension as measured by the Palpation Index, individuals with joint dysfunction as measured by the Dysfunction Index, and those with a combination of joint/muscle problems as reflected on the total Craniomandibular Index.

In summary, the study supported the contention that psychosocial variables in adolescence, especially multiple pain complaints, hypochodriasis, depression, and anxiety were associated with one form of TMD presentation. In general the integrated model proposed could not account for TMD in adolescents. There does seem to be two distinct syndromes, one more reminiscent of the Myofacial Pain dysfunction as described by Laskin (1969), and another representing a primary physical disorder manifesting early joint dysfunction.

The study findings underline the complexity of TMD even at an early age and the importance of adopting a bio-psychosocial model implying a multidisciplinary approach to both diagnosis and treatment. In further research an alternative integrated model might be considered emphasizing the relationship between personality characteristics and emotional stability, cognitive abilities and family coping styles.

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APPENDIX A

LETTER SENT TO DENTISTS

University of Alberta
Edmonton
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Temporomandibular Joint Investigation Unit
Faculty of Dentistry
4068 Dentistry/Pharmacy Centre, Telephone 492-2300

Oral and Maxillofacial Surgeons
E. Wayne Tunis
BSc, DDS, Dip. ABOMS, FRCD(c)
Martin R. Aidelbaum,
DDS, Cert. OMFS, MRCD(c)

Orthodontists
Ken E. Glover
BSc, DDS, Cert. Ortho., MSD, MRCD(c)
Paul W. Major
DDS, MSc, Dip. Ortho., MRCD(c)

Physiotherapist
Martin Parfitt
MCSP, MCPA

Prosthodontist
Keith H. Compton
BSc, DDS, Dip. Fix Pros, MS

Psychologist
Cynthia Blackman
MEd

Radiologists
David C. Hatcher
DDS, MSc, MRCD(c)
C. Grace Petrikowski
DDS, Dip. Oral Rad

Date

Addressee
Mailing Address

Dear Dr

I am presently pursuing a research project on head and neck pain in adolescents as part of the requirements for my Ph.D. The project is being carried out in association with the TMJ Investigation Unit at the Department of Dentistry, University of Alberta.

The Temporomandibular Joint Investigation Unit at the University of Alberta is currently developing research protocols to better diagnose and treat patients with cranial dysfunction. The Unit has been in existence for 6 years and utilizes a multidisciplinary approach in the diagnosis and treatment of patients referred to it by the medical and dental communities.

This current research project requires adolescent subjects between 12 and 16 years of age. These adolescents will present with local or general face and/or head pain that we suspect of exhibiting dysfunction of the masticatory and temporomandibular complexes.

All participants will receive, at no cost, an extensive and comprehensive clinical evaluation of their dental, musculoskeletal, and psychological states. They will also be asked to complete a series of questionnaires elucidating psychological and physiological variables.

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All information will be kept in the strictest confidence and should you so request, a summary of our diagnosis and treatment protocol will be forwarded to you.

The size and scope of this study requires an extensive body of subjects, and only your participation in referring candidates that could fall within the parameters set out above will enable us to continue.

If you have any patients you wish to refer, please phone the TMJ Clinic at 492-2300. If you would like further information, please do not hesitate to contact me at my office, 488-8203.

Thanking you for your anticipated cooperation with this project.

Yours sincerely,

Cynthia Blackman, M. Ed.
Chartered Psychologist

CB:dam

APPENDIX B

LETTER SENT TO PHYSICIANS

University of Alberta
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Psychologist
Cynthia Blackman
MEd

Radiologists
David C. Hatcher
DDS. MSc. MRCD(c)
C. Grace Petrikowski
DDS. Dip. Oral Rad.

Date

Addressee
Mailing Address

Dear Dr

I am presently pursuing a research project on head and neck pain in adolescents as part of the requirements for my Ph. D. The project is being carried out in association with the TMJ Investigation Unit at the Department of Dentistry, University of Alberta.

Basically the study is an attempt to improve diagnostic definition of head and facial pain including headaches and earaches in this age group. I hope to elucidate the relationship between TMD, atypical facial pain, headaches, life stress and psychosocial variables.

I am seeking your cooperation in obtaining patient volunteers to participate in the study. All study participants will be given a full dental examination free of charge, and will be expected to fill out a number of psychological questionnaires.

The study has been approved by the Ethics Committee of the Department of Dentistry, and full confidentiality will be observed at all times. Patient's names will not be used in the study report.

Suitable study subjects will be adolescents between the ages of 12 and 16 years, presenting at your offices with headaches or facial pain, without obvious cause, with or without associated features of TMJ.

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If you have any patients you wish to refer, please phone the TMJ Clinic at 492-2300. If you would like further information, please feel free to phone me at 488-8203.

Thanking you for your anticipated cooperation with this project.

Yours sincerely,

Cynthia Blackman, M. Ed.
Chartered Psychologist

CB:dam

APPENDIX C

CONSENT FORM FOR ADOLESCENTS

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Psychologist
Cynthia Blackman
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Radiologists
David C. Hatcher
DDS. MSc. MRCD(c)
C. Grace Petrikowski
DDS. Dip. Oral Rad.

ADOLESCENT CONSENT

I acknowledge that the research procedures described on the information sheet of which I have a copy have been explained to me, and that any questions that I have asked have been answered to my satisfaction.

In addition, I know that I may contact the person designated on this form if I have any further questions both now or in the future. I have been assured that personal records will be kept confidential and that records will only be released to my dentist/doctor with my permission. I understand that I am free to withdraw from this study at any time without jeopardy to my continuing dental care. I further understand that if the study is not undertaken, or if it is discontinued at any time, the quality of my dental care will not be affected. I understand that if any knowledge gained from the study is forthcoming that could influence my decision to continue this study, I will be promptly informed.

______________________________ *(NAME)*	______________________________ *(NAME)*
______________________________ *(SIGNATURE)*	______________________________ *(SIGNATURE OF WITNESS)*
______________________________ *(DATE)*	
______________________________ *(SIGNATURE OF INVESTIGATOR OR DESIGNEE)*	

The person who may be contacted about this research is:

Ms. Cynthia Blackman, M.Ed.
at: 492-2300 or
488-8203

APPENDIX D

CONSENT FORM FOR PARENTS

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Cynthia Blackman
MEd

Radiologists
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DDS, MSc, MRCD(c)

C. Grace Petrikowski
DDS, Dip. Oral Rad

PARENTAL CONSENT

I acknowledge that the research procedures described have been explained to me, and that any questions that I have asked have been answered to my satisfaction. In addition, I know that I may contact the person designated on this form if I have any further questions, both now or in the future. I have been assured that personal records will be kept confidential and that records will only be released to my dentist/doctor with my permission. I understand that my child is free to withdraw from this study at any time without jeopardy to his/her continuing dental care. I further understand that if the study is not undertaken, or if it is discontinued at any time, the quality of my child's dental care will not be affected.

I understand that if any knowledge gained from the study is forthcoming that could influence my decision to allow my child to continue this study, I will be promptly informed.

______________________	______________________
NAME	NAME
______________________	______________________
SIGNATURE	SIGNATURE

____
DATE

____
SIGNATURE OF INVESTIGATOR
OR DESIGNEE

The person who may be contacted about the research is:

Cynthia Blackman, M. Ed.
492-2300 or 488-8203

APPENDIX E

ADOLESCENT INTAKE QUESTIONNAIRE

1

1

TMD RESEARCH STUDY - INTAKE FORM

CONFIDENTIAL PARTICIPANT INFORMATION

Date of Birth: / / School Grade:_____
Day Month Year

I.D.:____ AGE:____ SEX: Male/Female

This questionnaire has been made to enable us to get to know more about you for the purposes of this study and may be of benefit to your treatment. You will find that questions involve a number of different areas of your life including some background of your present pain problems. This information is for the purposes of the study only and is confidential between you and the study researchers. No information from your answers will be given to your parents or doctor without your permission.

You will generally be asked to mark a circle around the "yes" or "no" answer that reflects your response. Alternatively you may be asked to mark a number that represents your answer. There is no right or wrong answer. Just select the response that most accurately says how you feel. Please do not leave any unanswered questions.

Once again, thank you for your time and cooperation in completing this questionnaire.

TMD STUDY INTAKE FORM

The first part of this study concerns problems that you may have with pain. We are interested in hearing about any pain that you have had that lasted for at least one day, or that happened several times over the past year. This includes pains from injury, illness, or other causes. Please do not include very brief pains that occurred only once or for a very short time.

To answer each question, please circle the number of the best answer that applies to you.

Example: 1) Are you going to school.....NO...0
YES 1

(Circle your response)

PERSONAL PAIN PROBLEMS

1) Have you ever had a problem with pain in any of the following areas?

a) Back pain.................... Yes..1
No...0

b) Severe headaches or migraines. Yes..1
No...0

c) Chest pain................... Yes..1
No...0

d) Stomach ache or pain......... Yes..1
No...0

e) Face or jaw pain............. Yes..1
No...0

f) Pain in front of the ear..... Yes..1
No...0

g) Pain inside the ear.......... Yes..1
(not from infection) No...0

FAMILY PAIN PROBLEMS

We would like to know if any other members of your family ever suffer now or has suffered from aches and pains. We are interested in aches or pains that lasted at least one day or perhaps occurred several times over the past year.

2) Has any member of your family had problems with pain in any or all of the following area?

a)	Back pain....................	Yes..1 No...0
b)	Severe headaches or migraines.	Yes..1 No...0
c)	Chest pain...................	Yes..1 No...0
d)	Stomach ache or pain.........	Yes..1 No...0
e)	Face or jaw pain.............	Yes..1 No...0
f)	Pain in front of the ear.....	Yes..1 No...0
g)	Pain inside the ear.......... (not from infection)	Yes..1 No...0

PREVIOUS PROBLEM INQUIRY

3) Have you been asked to see any of the following in the past year? If yes, please state briefly the problem at the time:

			Nature of problem
a)	School Counsellor..	Yes..1 No...0	
b)	Psychologist.......	Yes..1 No...0	
c)	Psychiatrist.......	Yes..1 No...0	

HEADACHES OR MIGRAINES OVER THE PAST SIX MONTHS

In this part of the form we are interested in finding out if you have ever suffered from headaches or other migraines over the past six months.

4) During the last six months have you ever had any headache or migraines:................ Yes..1
No...0

5) If you answered yes to question 4), which of the phrases below best describes how often the headaches or migraines occur?

Never...................... 0
Almost every day........... 1
More than half the days.... 2
Less than half the days.... 3
Several times only......... 4
Only once.................. 5

6) How long did each episode of headache or migraine last one each occasion?

Never...................... 0
Less than one hour......... 1
One to three hours......... 2
Four to eight hours........ 3
Nine to sixteen hours...... 4
More than sixteen hours.... 5

7) Mark your usual pain level on the scale below on a scale from very mild to severe by placing a mark at the point that represents your usual pain.

very mild very severe

8) When you are keyed up or anxious, do your muscles ever get tense enough for you to notice?
Yes..1
No...0

9) If you answered "yes", then which of your muscles are effected? Please include one or more muscle groups as appropriate:

	NEVER	SOMETIMES	ALWAYS
Head	0	1	2
Neck	0	1	2
Jaw	0	1	2
Shoulder	0	1	2
Back	0	1	2
Stomach	0	1	2
Arms	0	1	2
Legs	0	1	2

10) Please rate how much your headache or migraine interfered with your daily activities on the scale below. (1 is never - 5 is always)

1	2	3	4	5
Never interferes				Always interferes

11) How many days during the last six months were you absent from school because of your headaches or migraines?

Number of days absent
None..................... 0
Once per month........... 1
Once per week............ 2
More than once per week.. 3

FACIAL ACHES AND/OR JAW PAIN

In this part of the form we are interested in finding out if you have ever suffered from facial aches and/or jaw pain over the past six months:

12) During the last six months have you ever had any facial ache and/or jaw pain?
Yes..1
No...0

13) If you answered "yes" to question 12), which of the phrases below best describes how often the facial aches and/or jaw pains occur?

Never..................... 0
Almost every day.......... 1
More than half the days... 2
Less than half the days... 3
Several times only........ 4
Only once................. 5

14) How long did each episode of facial ache and/or jaw pain last on each occasion?

Never..................... 0
Less than one hour........ 1
One to three hours........ 2
Four to eight hours....... 3
Nine to sixteen hours..... 4
More than sixteen hours... 5

15) Mark your usual facial ache or jaw pain level on the scale below, from the mildest pain felt to the most severe pain felt. Place a mark on the line which reflects your usual pain:

very mild — very severe

16) Please rate how much your facial ache and/or jaw pain interfered with your daily activities on the scale below. (1 is never - 5 is always)

1 2 3 4 5
Never interferes — Always interferes

17) Do you have any headache with your facial ache and/or jaw pain?
Yes..1
No...0

18) Is your face or jaw pain on:
neither side ... 0
the left side..... 1
the right side.... 2
both sides.... 3

SOCIAL SUPPORT

19) This series of questions concerns the amount of support that you feel you get from your family when you have problems by responding to the following statement. On this scale 1 is strong disagreement and 5 is strong agreement:

	STRONGLY DISAGREE				STRONGLY AGREE
a) My family is supportive	1	2	3	4	5
b) My family is sympathetic	1	2	3	4	5
c) My family doesn't understand	1	2	3	4	5
d) My family expects me to take care of it myself	1	2	3	4	5
e) My family gets upset and irritable	1	2	3	4	5
f) My family leaves me alone	1	2	3	4	5
g) My family blames me for the problem	1	2	3	4	5
h) My family takes over my chores	1	2	3	4	5
i) My family helps me deal with the problem	1	2	3	4	5
j) I can safely confide in my family	1	2	3	4	5

20) This series of questions concerns the amount of support that you feel you get from your friends when you have problems, by responding to the following statements. 1 is strong disagreement, 5 is strong agreement.

	STRONGLY DISAGREE				STRONGLY AGREE
a) My friends are supportive	1	2	3	4	5
b) My friends are sympathetic	1	2	3	4	5
c) My friends don't understand	1	2	3	4	5
d) My friends expect me to take care of it myself	1	2	3	4	5
e) My friends get upset and irritable	1	2	3	4	5
f) My friends leave me alone	1	2	3	4	5
g) My friends blame me for the problem	1	2	3	4	5
h) My friends take over my chores	1	2	3	4	5
i) My friends help deal with the problem	1	2	3	4	5
j) You can safely confide in my friends	1	2	3	4	5

21) When you are upset or are in trouble or under stress, how much support do you feel that you get from:

	NONE	A LITTLE	SOME	A GREAT DEAL
Family members	1	2	3	4
Close friends	1	2	3	4
Teachers	1	2	3	4
Others (specify)	1	2	3	4

GENERAL HEALTH

22) Compared to other people of your own age, how do you rate your general health?

Excellent	1
Good	2
Fair	3
Poor	4

23) Overall, how would you rate your level of ability or accomplishments in the following areas?

	EXCELLENT	ABOVE AVERAGE	AVERAGE	BELOW AVERAGE
School work and grades	1	2	3	4
General intelligence	1	2	3	4
Athletic ability	1	2	3	4
Musical/Artistic ability	1	2	3	4
General creativity	1	2	3	4
Physical condition	1	2	3	4
Social skills	1	2	3	4
Other (specify)	1	2	3	4

24) Do you have any hobbies or interests? If so, please list them below:

----

25) Do you or have you used any of the following:

	NEVER	SOMETIMES	WEEKLY	DAILY
Coffee	0	1	2	3
Tea	0	1	2	3
Soda (Pepsi/Coke/Jolt)	0	1	2	3
Beer	0	1	2	3
Alcohol	0	1	2	3
Cigarettes	0	1	2	3
Marijuana (Pot/Weed)	0	1	2	3
Other drugs	0	1	2	3

26) If you are presently taking medications, give to you by your physician, state what they are and how often you have to use them:

MEDICAL AND ILLNESS HISTORY

27) What does your most frequent pain feel like? (Choose the best word)

a) dull b) sharp c) burning
d) throbbing e) pressure f) stabbing
g) tingling h) shooting i) numb
j) cramping

28) What is the second word you would choose to describe your most frequent pain?

a) dull b) sharp c) burning
d) throbbing e) pressure f) stabbing
g) tingling h) shooting i) numb
j) cramping

29) How has the problem changed since it began?

a) worst b) worse c) same
d) better e) no problem f) possible

30) Have you had any of these symptoms in the past six months?

	YES	*NO*	*DON'T KNOW*
a) Jaw shakes	___	___	___
b) Tongue pain	___	___	___
c) Double vision	___	___	___
d) Seeing a halo	___	___	___
e) Hearing difficulty	___	___	___
f) Itchy/Plugged ears	___	___	___
g) Noise in jaws	___	___	___
h) Taste changes	___	___	___
i) Soreness in teeth/gums	___	___	___
j) Headaches	___	___	___
k) Eye strain	___	___	___
l) Blurred vision	___	___	___
m) Earaches	___	___	___
n) Ringing in ears	___	___	___
o) Vertigo (spinning)	___	___	___
p) Locking/restricted jaws	___	___	___
q) Jaw/facial pain	___	___	___
r) Bite feels off	___	___	___
s) Neck lumps or swelling	___	___	___
t) Sore throat	___	___	___
u) Voice difficulties	___	___	___
v) Loose teeth	___	___	___
w) Shortness of breath	___	___	___
x) Cold hands	___	___	___
y) Horse voice	___	___	___
z) Tight throat	___	___	___
aa) Constant need to clear throat	___	___	___
bb) Swelling in gums	___	___	___
cc) Congested nose or sneezing	___	___	___
dd) Racing heart	___	___	___
ee) Frequent fever	___	___	___
ff) Chest pain	___	___	___
gg) Unusual sweating	___	___	___
hh) Hot flashes	___	___	___
ii) Fatique	___	___	___
jj) Vomiting	___	___	___
kk) Nausea	___	___	___
ll) Arm pain/tingling	___	___	___
mm) Neck/shoulder pain	___	___	___

nn) Mid back pain	___	___	___
oo) Painful feet	___	___	___
pp) Tendency to shake/tremble	___	___	___
qq) Dizziness	___	___	___
rr) Speech difficulty	___	___	___
ss) Swollen feet or ankles	___	___	___
tt) Bleed easily	___	___	___
uu) Swollen glands	___	___	___
vv) Weakness	___	___	___
ww) Itching/burning skin	___	___	___
xx) Constipation	___	___	___
yy) Kidney problems	___	___	___
zz) Low back pain	___	___	___
aaa) Hip pain	___	___	___
bbb) Aching joints/muscles	___	___	___
ccc) Swollen joints	___	___	___
ddd) Convulsions	___	___	___
eee) Numbness	___	___	___
fff) Fainting/blackouts	___	___	___

31) Are the symptoms made worse by:

	YES	*NO*	*DON'T KNOW*
a) Bright lights	___	___	___
b) Chewing	___	___	___
c) Stress	___	___	___
d) Riding in a car	___	___	___
e) Loud noises	___	___	___
f) Touching area	___	___	___
g) Yawning	___	___	___
h) Fatigue	___	___	___
i) Certain foods/drinks	___	___	___
j) Weather changes	___	___	___
k) Socializing	___	___	___
l) Working	___	___	___
m) Talking	___	___	___
n) Vigorous exercise	___	___	___
o) Early morning hours	___	___	___

32) Are the symptoms reduced by:

	YES	NO	DON'T KNOW
a) Heat	___	___	___
b) Massage/rubbing	___	___	___
c) Distraction	___	___	___
d) Mild activity	___	___	___
e) Cold	___	___	___
f) Sleep	___	___	___
g) Rest/laying down	___	___	___
h) Exercise	___	___	___
i) Being alone	___	___	___

33) What activities does the problem prevent you from doing normally?

	YES	NO	DON'T KNOW
a) Chewing	___	___	___
b) Riding in a car/bus	___	___	___
c) Sleeping	___	___	___
d) Socializing (acquaintances)	___	___	___
e) Household chores	___	___	___
f) Part-time job	___	___	___
g) Sitting a long time	___	___	___
h) Swallowing	___	___	___
i) Talking	___	___	___
j) Personal hygiene	___	___	___
k) Socializing (friends/family)	___	___	___
l) Reading	___	___	___
m) Full-time job	___	___	___
n) Standing a long time	___	___	___
o) Yawning	___	___	___
p) Fixing meals	___	___	___
q) Active sports	___	___	___
r) Driving	___	___	___
s) Laying down	___	___	___
t) Hard exercise	___	___	___
u) Drinking	___	___	___

v) Eating	___	___	___
w) Discussing problems	___	___	___
x) Active hobbies	___	___	___
y) Yard work	___	___	___
z) Walking long distances	___	___	___
aa)Mild exercise	___	___	___
bb)Going to school	___	___	___

34) The onset of the problem was associated with:

	YES	NO	DON'T KNOW
a) Jaw surgery	___	___	___
b) Blow to jaw/head/neck	___	___	___
c) Motor vehicle accident	___	___	___
d) Dental work	___	___	___
e) Chewing	___	___	___
f) Tooth extraction	___	___	___
g) Orthodontics	___	___	___
h) Stressful situation	___	___	___
i) Nothing, pain just came on	___	___	___
j) Other (specify)____________	___	___	___

35) How fast did these symptoms come on?

	YES	NO	DON'T KNOW
a) Over years	___	___	___
b) Over months	___	___	___
c) Over weeks	___	___	___
d) Over days	___	___	___
e) Suddenly	___	___	___

36) How often does the problem generally occur?

	YES	NO	DON'T KNOW
a) Constant	___	___	___
b) Once an hour	___	___	___
c) Once a day	___	___	___
d) Once a week	___	___	___
e) Once a month	___	___	___
f) Never	___	___	___

37) Is there anything else you think that we should know about your pain?

____
____
____
____

38) How intense is your level of symptoms?

zero — the most that can be imagined

39) How unpleasant or disturbing is your usual level of symptoms?

zero — the most that can be imagined

40) How difficult is it to endure the problem over time?

no difficulty — the most that can be imagined

41) How often do the symptoms generally occur?

never 1/month 1/day 1/hour constant

42) When the symptoms occur, how long do the symptoms usually last?

never 1/min 1/hr 1/day 1/wk continuous

43) Do you have any of the following habits?

	NEVER	SOMETIMES	ALWAYS
Clenching your jaw	0	1	2
Grinding your teeth	0	1	2
Chewing gum	0	1	2
Pursing your lips	0	1	2
Thrusting your jaw forward	0	1	2
Tongue thrusting	0	1	2
Nail biting	0	1	2
Chewing pencils or other items	0	1	2
Sucking thumb or fingers	0	1	2

THANK YOU FOR COMPLETING THIS FORM

APPENDIX F

PARENT QUESTIONNAIRE

TMD RESEARCH STUDY

THIS QUESTIONNAIRE HAS BEEN MADE TO ENABLE US TO GET TO KNOW MORE ABOUT YOUR CHILD FOR THE PURPOSES OF THIS STUDY AND TO HELP US DIAGNOSE THEIR PROBLEMS. YOU WILL FIND THAT QUESTIONS INVOLVE A NUMBER OF DIFFERENT AREAS INCLUDING SOME BACKGROUND OF THEIR PRESENT PAIN PROBLEMS. THIS INFORMATION IS FOR THE PURPOSES OF THE STUDY ONLY AND IS CONFIDENTIAL BETWEEN YOU AND THE STUDY RESEARCHERS. NO INFORMATION FROM YOUR ANSWERS WILL BE RELEASED WITHOUT YOUR PERMISSION.

YOU WILL GENERALLY BE ASKED TO PLACE A CHECK MARK BESIDE THE ANSWER THAT REFLECTS YOUR RESPONSE. JUST SELECT THE RESPONSE THAT IS THE MOST ACCURATE. PLEASE DO NOT LEAVE ANY UNANSWERED QUESTIONS. FEEL FREE TO ASK THE RESEARCH ASSISTANT FOR HELP IF THERE ARE QUESTIONS YOU DO NOT UNDERSTAND. ONCE AGAIN, THANK YOU FOR YOUR TIME AND COOPERATION IN COMPLETING THIS QUESTIONNAIRE.

Number of children in your family: _____

Ages: _____
_____
_____
_____
_____

Does your child live with: (Please place checkmark in correct space)

Both parents	_____
Single Mother	_____
Single Father	_____
Foster Home	_____
Other	_____

Parents' Occupations:

*Mother:*____

*Father:*____

How many days has your child been absent from school as a result of his/her jaw/facial problem:______________________

1) Primary job status (Yourself):
A) Full-time___ B) Part-time___ C) Disabled___
D) Unemployed___ E) Retired___ F) Homemaker___
G) No answer___ H) Full-time Student___

2) Present family income (Per year in thousands):
A) No answer___ B) Under 15___ C) 15 to 30___
D) 30 to 50__ E) Over 50___

3) Education level (Last year completed):
A) No formal education___ B) Grade School___
C) High School___ D) Voc/Tech School___
E) College___ F) University___
G) Graduate___ H) Post Graduate___

4) Highest degree awarded to you:
A) High School___ B) Voc/Tech Cert.___
C) Assoc. Degree___ D) BS/BA___
E) MS/MA___ F) Post Graduate___
G) Professional Designation___ H) None___

MEDICAL AND ILLNESS HISTORY

1) How has the problem chanced since it began:
A) Worst possible___ B) Worse___
C) Same___ D) Better___
E) No problem___

2) Does your child have or have they had any of these illnesses/conditions:

	YES	*NO*	*DON'T KNOW*
Rheumatoid arthritis	___	___	___
Lupus	___	___	___
Collagen disease	___	___	___
Cancer	___	___	___
Tuberculosis	___	___	___
Kidney problems	___	___	___
Juvenile onset diabetes	___	___	___
Alcoholism/drug dependency	___	___	___
Stomach problems	___	___	___
Sexually transmitted disease	___	___	___
Hepatitis	___	___	___
Cluster headache	___	___	___

	YES	NO	DON'T KNOW
Chronic liver disease	___	___	___
Impacted wisdom teeth	___	___	___
Scoliosis	___	___	___
TJM disorder	___	___	___
Heart disease	___	___	___
Rheumatic fever	___	___	___
Thyriod disease	___	___	___
Nervous disorder	___	___	___
Pregnancy	___	___	___
Premenstrual syndrome	___	___	___
Parathyriod disease	___	___	___
Anemia	___	___	___
Migraine headaches	___	___	___
Psychiatric disorder	___	___	___
Bronchitis	___	___	___
Sinus problems	___	___	___
Epilepsy	___	___	___
Head injury	___	___	___
Traffic accidents	___	___	___
Recent dental work	___	___	___
Nutritional deficiency	___	___	___
Hives or rashes	___	___	___
Fibromyalgia/fibrositis	___	___	___
Asthma	___	___	___
Fractures	___	___	___
Concussion	___	___	___
Visual problems	___	___	___
Whiplash	___	___	___

3) Has your child had any of these tests for the problems:

	YES	NO	DON'T KNOW
X-rays	___	___	___
Magnetic resonance image (MRI)	___	___	___
Nerve block	___	___	___
Diet analysis	___	___	___
Arthrogram	___	___	___
EMG	___	___	___
Blood studies	___	___	___
CT Scan (CAT)	___	___	___
Tooth pulp test	___	___	___
Tomograms	___	___	___

4) Has your child seen any of these Health/Helping Professionals for the problem:

	YES	*NO*	*DON'T KNOW*
Acupuncturist	___	___	___
Clergy	___	___	___
Ear/nose/throat specialist	___	___	___
Neurologist	___	___	___
Orthopedist	___	___	___
Oral surgeon	___	___	___
Physical medicine specialist	___	___	___
Insurance physician	___	___	___
Internist	___	___	___
Psychologist	___	___	___
Nutritionist	___	___	___
Anesthesiologist	___	___	___
Opthalmologist	___	___	___
Dentist	___	___	___
Rheumatologist	___	___	___
Psychiatrist	___	___	___
Psychiatrist	___	___	___
Chiropractor	___	___	___
Occupational therapist	___	___	___
General practitioner	___	___	___
Neurosurgeon	___	___	___
Physical therapist	___	___	___
Other (please specify)	___	___	___
______________________________	___	___	___

5) What treatments has your child had for the problem:

	YES	*NO*	*DON'T KNOW*
Traction	___	___	___
Injections/nerve blocks	___	___	___
Acupuncture	___	___	___
Massage/accupressure	___	___	___
Biofeedback	___	___	___
TMJ Surgery	___	___	___
Orthodontics/braces	___	___	___
Hypnosis	___	___	___
Electrical stimulation (TENS)	___	___	___
Ultrasound or iontophoresis	___	___	___
Root canal/dental treatment	___	___	___
Splints or bite planes	___	___	___

	YES	NO	DON'T KNOW
Counselling	___	___	___
Medications	___	___	___
Heat/cold applications	___	___	___
Stress management	___	___	___
Drug/alcoholism rehabilitation	___	___	___
Pain program	___	___	___
Chiropractic treatment	___	___	___
Exercise	___	___	___
Neurosurgery	___	___	___
Other (please specify)	___	___	___
______________________	___	___	___

APPENDIX G

BASIC PERSONALITY INVENTORY

BPI

Douglas N. Jackson, Ph.D.

DIRECTIONS

On the following pages you will find a series of statements which a person might use to describe himself. Read each statement and decide whether or not it describes you. Then indicate your answer on the separate answer sheet. If you agree with a statement or decide that it does describe you, answer TRUE. If you disagree with a statement or feel that it is not descriptive of you, answer FALSE. In marking your answers on the answer sheet, be sure that the number of the statement you have just read is the same as the number on the answer sheet.

Answer every statement either true or false, even if you are not completely sure of your answer.

Published by Research Psychologists Press, Inc.

1. It's easy for me to keep fit and healthy.
2. My present situation is hopeless.
3. I care about what other people think of me.
4. Sometimes I feel like smashing things.
5. I would enjoy betting on horses.
6. No one is making things work out badly for me.
7. I feel frightened when I have to go out alone.
8. I never have visions in which imaginary people or things appear.
9. Many times I act without thinking.
10. I enjoy being with people.
11. I have given up hope of ever amounting to anything.
12. I frequently think of the same silly thing over and over for hours.
13. Sometimes ~~my legs~~ lose their strength so that I can't walk.
14. I rarely feel disappointed.
15. Very few things excite me.
16. I would never intentionally hurt someone's feelings.
17. For the most part people are honest.
18. Someone has stolen my free will.
19. Even at the end of a hard day, I remain relaxed and at ease.
20. I seem to hear an unknown voice wherever I go.
21. I would not do something foolhardy just for the fun of it.
22. I keep my distance from other people.
23. I deserve my share of good luck.
24. There have been days when I have done things without being able to recall anything at all about them.
25. I am free of aches and pains.
26. There is not much to be interested in any more.
27. Some movies make me quite happy or sad.
28. No one gets away with insulting me.

GO ON TO NEXT PAGE

29. I have been in trouble with the law more than once.
30. I rarely feel that someone is trying to get the best of me.
31. Although I really try, I cannot stop feeling tense.
32. I do not experience peculiar voices warning me of danger.
33. I often behave in a reckless manner.
34. I like to speak to strangers.
35. I am only suited for the lowest and most simple sort of work.
36. I sometimes have fits and seizures that I cannot control.
37. My stomach is easily upset.
38. My future is cheery.
39. I would not be tempted by a promise of getting something for nothing.
40. I can get along quite well with irritable people.
41. No matter how easy or safe it was, I would never steal money.
42. I can tell that someone has searched through my possessions a number of times.
43. I remain quite cool when things go badly.
44. Fancy colored lights sometimes float through my brain.
45. Ideas do not race through my head faster than I can speak them.
46. Most of the time I prefer to be alone.
47. I am the type of person who can be relied upon.
48. I don't think my life is worth living.
49. I seldom have any bodily discomfort.
50. I live a gloomy and boring life.
51. At times I say things about my friends that aren't nice.
52. If someone does something I dislike, I usually tell that person about it.
53. I would enjoy cheating certain people.
54. I never have the feeling that someone is out to do away with me.
55. It frightens me to think about things that bother me.
56. Ordinary things never appear "foggy" or far away to me.

57. Sometimes I suddenly get up and act without warning or reason.
58. I would rather work with a group of people than by myself.
59. I am no good to anyone.
60. I have nightmares almost every night.
61. My skin is often red and inflamed.
62. I enjoy just about everything I do.
63. I never weep or feel like weeping.
64. I don't mind having someone tell me what to do.
65. I know of no excuse for taking advantage of someone of the opposite sex.
66. I feel that I am in great danger from those who wish to harm me.
67. Other people's actions rarely make me anxious.
68. I sometimes hear voices which no one else understands.
69. I am careful in almost everything I do.
70. I try not to get involved in conversations with others.
71. I think my parents would have reason to be proud of me.
72. I have strange fears of places and things.
73. My back does not bother me.
74. Others seem to lead happier lives than I do.
75. I can remember a few unpleasant things about my childhood.
76. Slow people make me angry.
77. I think that I could commit a crime and get away with it.
78. I rarely feel that people look for my weaknesses.
79. I worry when a train or bus is late.
80. I never confuse my own thoughts with a real person talking to me.
81. I'll try almost anything regardless of the consequences.
82. I have a number of close friends.
83. My whole life is one big mistake.
84. I have periods when my mind races ahead so fast that I cannot think clearly.

GO ON TO NEXT PAGE

85. Whenever I am worried about something I get cramps.
86. I live a very satisfying and rewarding life.
87. I am careful not to have any bad thoughts.
88. My family life has been happy and free of arguments.
89. Most salespeople would not cheat a customer.
90. When people whisper, I feel they might be talking about me.
91. I have the ability to concentrate without my mind wandering.
92. I see bright pictures in my head when I don't want to.
93. I can work for a reasonable length of time without becoming bored.
94. I avoid speaking with people as much as I can.
95. I usually do most of my daily tasks quite well.
96. I have no interest at all in the opposite sex.
97. I seldom have a cough or sore throat.
98. Life is extremely dull for me.
99. I try to avoid jobs I dislike.
100. Bossy people can expect an argument from me.
101. No one does things for nothing.
102. Most people treat me openly without hiding anything.
103. Sometimes my own thoughts scare me so much that I think I'm going to pass out.
104. My memory is as good as it ever was.
105. I often take risks without stopping to think about the results.
106. I dislike going out alone.
107. People are better off without me.
108. I frequently experience terrible headaches.
109. I often have pains in odd parts of my body.
110. Something interesting happens to me almost every day.
111. I am never cross with a loved one.
112. I avoid quarreling with others.

113. Gambling has no appeal to me.
114. I often have the feeling that I am not liked.
115. I generally feel quite comfortable when being introduced to strangers.
116. I can't always decide whether a minute or an hour has passed.
117. I am not the type to be bored one minute and excited about something the next.
118. I am happier alone than when with others.
119. Most people find me an interesting person to talk with.
120. If things don't improve for me, I may have to do something violent or dangerous.
121. I hardly ever have "splitting" headaches.
122. I often have trouble sleeping because I feel so sad.
123. On some days I am more easily annoyed than on others.
124. I like to run my own life without interference from anyone.
125. I admire a successful professional thief.
126. I never feel like a machine that someone else plugs in and uses.
127. When I am startled my heart seems to skip a beat and stop.
128. Things don't appear unusually different to me right now.
129. I am usually somewhat restless.
130. I like talking to just about anyone I meet.
131. I do not consider myself worthy of other people's kindness.
132. There have been periods of time when I have used alcohol to excess.
133. Sometimes I get so dizzy I can hardly stand up.
134. I always look forward to a new day.
135. I have never lied to anyone.
136. I believe in obeying those in authority.
137. I was not regarded as a behavior problem by my school teachers.
138. I am greatly concerned with what people think about me.
139. Emergencies seldom make me nervous.
140. I often see shadows and think they are people or animals.

GO ON TO NEXT PAGE

141. My feelings about people do not change much from day to day.
142. I don't care whether or not the people around me are my friends.
143. I enjoy the respect of most people who know me.
144. I have often used dangerous drugs and chemicals.
145. I generally feel warm enough.
146. I don't think things will ever get any better for me.
147. Occasionally I use my friends to my own advantage.
148. I dislike working for a person who is too strict.
149. Someone is always trying to trick you.
150. I am sure that there is no gossiping about me.
151. Little things often upset me.
152. I usually know about what time it is.
153. I often leave jobs unfinished.
154. When I am not feeling well, I like to have someone around to comfort me.
155. I am not a particularly kind person.
156. I would enjoy watching someone suffer great pain.
157. I often have eye strain upon completing a day's work.
158. I believe that life is worth living.
159. I don't like thinking about personal problems.
160. I take great pains to be careful about other people's feelings.
161. There are many things I consider wrong and wouldn't do.
162. I often feel that others are trying to keep me out of their group.
163. I remain calm even in the most trying situations.
164. I often have the feeling that imaginary things are happening to me.
165. I generally make careful plans.
166. I am not considered sociable.
167. I think I would make a very good leader.
168. I do not care what happens to me.

169. My joints give me no trouble.
170. I feel depressed most of the time.
171. As a child I sometimes felt that my parents acted unfairly.
172. If someone hurts me, I remember it until I can get even.
173. People are always trying to get away with something.
174. No one has a magical power to control me.
175. I am sometimes disturbed by things that I know can't hurt me.
176. Even when left alone, I can find my way around easily.
177. At times I am rather careless.
178. I enjoy being neighborly.
179. I often show poor judgment about things.
180. I am very much attracted to members of my own sex.
181. I have poor blood circulation.
182. I am quite content with my life as it is now.
183. I admit my mistakes without ever trying to hide anything.
184. I seldom feel like hitting anyone.
185. I would feel very guilty if I were caught doing something wrong.
186. I never feel comfortable eating food prepared by others.
187. I don't worry over what might happen to me.
188. At times my surroundings change so much that I think I'm somewhere else.
189. I never take unnecessary chances.
190. I don't feel I need other people.
191. I feel capable of handling many difficult jobs.
192. I have been in serious trouble with the law.
193. I have a good deal of energy.
194. I dislike doing anything new.
195. My feelings are sometimes hurt by loved ones.
196. I dislike being ordered around by anyone.

GO ON TO NEXT PAGE

197. I would do just about anything for money.

198. If I fail at something I can only blame myself.

199. I am usually too afraid to try anything new.

200. I never see things that other people cannot see.

201. I usually say the first thing that comes into my mind.

202. I truly enjoy myself at social events.

203. People don't like me because I have so many faults.

204. I spend a great deal of time daydreaming about things that only I know.

205. I lose my breath easily.

206. I am usually a happy person.

207. I've never let down a friend in any way.

208. I do not easily lose patience with others.

209. Most people do what they can to help others.

210. I'm usually the first to be blamed if something goes wrong.

211. Things that upset other people usually do not bother me.

212. I cannot separate my daydreams from the real world.

213. I have a well thought out reason for almost everything I undertake.

214. I like to keep my ideas to myself.

215. I consider myself to be a generous and pleasant person.

216. I have been planning to do away with myself.

217. I never feel faint.

218. Recent events have made me feel downhearted and miserable.

219. Sometimes I deliberately avoid a person I dislike.

220. I get very irritated when someone disagrees with me.

221. I sometimes have fun teasing animals.

222. No one is trying to ruin my life.

223. When I visit a strange place I become very upset.

224. I can easily understand simple directions.

225. I find it exciting to drive in a fast car.
226. I enjoy doing things with friends whenever I am able.
227. I am not the type of person one remembers after one meeting.
228. I do not care for anyone very much.
229. I get a lot of headaches.
230. I believe that I shall have my share of good luck.
231. I always meet my responsibilities.
232. No one could ever say that I am hot-tempered.
233. Sooner or later people who break the law get caught.
234. If certain individuals had not interfered, I would be more successful today.
235. I do not panic more quickly than the average person.
236. Many times I can hear mysterious voices all around me.
237. I seldom do silly things without thinking.
238. I make little effort to meet new people.
239. Much of what I say is worth paying attention to.
240. I always have difficulty sleeping.

The UNIVERSITY *of* WESTERN ONTARIO
Faculty of Social Science • Department of Psychology

August 15, 1990

Cynthia Blackman, M.Ed.
Edmonton Computest Psychological
Consulting Services Ltd.
Suite 308
11523-100 Avenue
Edmonton, Alberta
T5K 0J8

Dear Ms. Blackman:

You have my permission to employ the Basic Personality Inventory in your dissertation research.

Good luck.

Cordially,

Douglas N. Jackson

Douglas N. Jackson
Senior Professor of Psychology

DNJ:sjb

Social Science Centre • London, Ontario • Canada • N6A 5C2 • Telephone (519) 661-2067

APPENDIX H

THE MULTIDIMENSIONAL ASSESSMENT OF STRESSFUL LIFE EVENTS

HERE IS A LIST OF EVENTS THAT CAN HAPPEN TO PEOPLE. PLEASE CIRCLE "YES" OR "NO" TO SHOW IF EACH EVENT HAPPENED TO YOU MORE THAN A YEAR AGO. MAKE ANOTHER CIRCLE TO SHOW IF EACH EVENT HAPPENED DURING THE PAST YEAR. PLEASE CIRCLE ONE OF THE NUMBERS TO SHOW HOW HAPPY OR UNHAPPY EACH EVENT WOULD MAKE YOU FEEL IF IT HAPPENED. BE SURE TO ANSWER EACH ITEM BY MAKING THREE CIRCLES.

	HAPPENED MORE THAN A YEAR AGO		HAPPENED DURING THE PAST YEAR		VERY UNHAPPY		NEUTRAL		VERY HAPPY
1. Parents getting separated or divorced	yes	no	yes	no	1	2	3	4	5
2. Family members having a serious accident or illness	yes	no	yes	no	1	2	3	4	5
3. Hanging out with a new group of friends	yes	no	yes	no	1	2	3	4	5
4. Getting into trouble with with the law	yes	no	yes	no	1	2	3	4	5
5. Stealing something that is valuable	yes	no	yes	no	1	2	3	4	5
6. Given regular medication by a doctor	yes	no	yes	no	1	2	3	4	5
7. Falling deeply in love	yes	no	yes	no	1	2	3	4	5
8. Death(s) occurred in my family	yes	no	yes	no	1	2	3	4	5
9. Face breaking out with a lot of pimples	yes	no	yes	no	1	2	3	4	5
10. Brother or sister moving out	yes	no	yes	no	1	2	3	4	5
11. Starting to see a counsellor or psychologist	yes	no	yes	no	1	2	3	4	5
12. Mother or father changing jobs	yes	no	yes	no	1	2	3	4	5
13. Starting a hobby that takes a lot of time	yes	no	yes	no	1	2	3	4	5
14. Getting pregnant or getting someone pregnant	yes	no	yes	no	1	2	3	4	5
15. Deciding for sure whether or not to go to college	yes	no	yes	no	1	2	3	4	5

Page 2.

		HAPPENED MORE THAN A YEAR AGO		HAPPENED DURING THE PAST YEAR		VERY UNHAPPY		NEUTRAL		VERY HAPPY
16.	Thinking of ending my life	yes	no	yes	no	1	2	3	4	5
17.	Changing school	yes	no	yes	no	1	2	3	4	5
18.	Joining a club or interest group	yes	no	yes	no	1	2	3	4	5
19.	Getting into trouble at school for my behaviour	yes	no	yes	no	1	2	3	4	5
20.	Getting or giving venereal disease (VD)	yes	no	yes	no	1	2	3	4	5
1.	Meeting a teacher I like very much	yes	no	yes	no	1	2	3	4	5
22.	Family having serious money problems	yes	no	yes	no	1	2	3	4	5
23.	Getting my own stereo or television	yes	no	yes	no	1	2	3	4	5
24.	Parents arguing or fighting a lot	yes	no	yes	no	1	2	3	4	5
25.	Getting really sick or passing out from alcohol	yes	no	yes	no	1	2	3	4	5
26.	Running away from home	yes	no	yes	no	1	2	3	4	5
27.	Going out on dates regularly	yes	no	yes	no	1	2	3	4	5
28.	Getting poor grades in school	yes	no	yes	no	1	2	3	4	5
29.	Taking a vacation without my parents	yes	no	yes	no	1	2	3	4	5
30.	Starting to drive a car	yes	no	yes	no	1	2	3	4	5
31.	Breaking up with my boyfriend or girlfriend	yes	no	yes	no	1	2	3	4	5
32.	Family having to move to a new neighborhood	yes	no	yes	no	1	2	3	4	5
33.	Making money on my own	yes	no	yes	no	1	2	3	4	5
34.	Having a bad experience on PCP (angel dust)	yes	no	yes	no	1	2	3	4	5
35.	Getting religion	yes	no	yes	no	1	2	3	4	5

		HAPPENED MORE THAN A YEAR AGO		HAPPENED DURING THE PAST YEAR		VERY UNHAPPY		NEUTRAL		VERY HAPPY
36.	Mother or father getting married again	yes	no	yes	no	1	2	3	4	5
37.	Having a gay or lesbian experience	yes	no	yes	no	1	2	3	4	5
38.	Having a bad experience on a psychedelic drug	yes	no	yes	no	1	2	3	4	5
39.	Gaining a lot of weight	yes	no	yes	no	1	2	3	4	5
40.	Having a serious accident or illness	yes	no	yes	no	1	2	3	4	5
41	Losing my virginity	yes	no	yes	no	1	2	3	4	5
. .	Having a bad expereince on marijuana	yes	no	yes	no	1	2	3	4	5
43.	Mother or father drinking a lot	yes	no	yes	no	1	2	3	4	5

UNIVERSITY OF CALIFORNIA, LOS ANGELES UCLA

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DEPARTMENT OF PSYCHOLOGY
LOS ANGELES, CALIFORNIA 90024

September 5, 1990

TO: Cynthia Blackman

FROM: Michael D. Newcomb

SUBJ: Permission for Use of Instrument

I hereby grant you permission to use my instrument, "Multi-Dimensional Stress Inventory" in your thesis.

MDC/td

APPENDIX I

THE INTELLECTUAL ACHIEVEMENT RESPONSIBILITY SCALE

THE I.A.R. QUESTIONNAIRE

*NAME:*______________________________

*GRADE:*_____________________________

*BIRTHDATE:*__________________________

*SEX: MALE*_____ *FEMALE*_____

GENERAL INSTRUCTIONS

This questionnaire describes a number of common experiences most of you have in your daily lives. These statements are presented one at a time, and following each are two possible answers. Read the description of the experience carefully and then look at the two answers. Choose the ONE that MOST OFTEN describes what happens to you. Put a circle around the "A" or the "B" in front of that answer. Be sure to answer each question according to how you REALLY FEEL. If at any time you are uncertain about the meaning of a question, raise your hand and one of the persons who passed out the questionnaire will come and explain it to you.

1. If a teacher passes you to the next grade, would it probably be
  - *a) because she liked you, or*
  - *b) because of the work you did?*

2. When you do well on a test at school, is it more likely to be
  - *a) because you studied for it, or*
  - *b) because the test was especially easy?*

3. When you have trouble understanding something in school, is it usually
  - *a) because the teacher didn't explain it clearly, or*
  - *b) because you didn't listen carefully?*

4. When you read a story and can't remember much of it, is it usually
  - *a) because the story wasn't well written, or*
  - *b) because you weren't interested in the story?*

5. Suppose your parents say you are doing well in school. Is this likely to happen
- *a) because your school work is good, or*
- *b) because they are in a good mood?*

6. Suppose you did better than usual in a subject at school. Would it probably happen
- *a) because you tried harder, or*
- *b) because someone helped you?*

7. When you lose at a game of cards or checkers, does it usually happen
- *a) because the other player is good at the game, or*
- *b) because you don't play well?*

8. Suppose a person doesn't think you are very bright or clever.
- *a) can you make him change his mind of you try to, or*
- *b) are there some people who will think you're not very bright no matter what you do?*

9. If you solve a puzzle quickly, is it
- *a) because it wasn't a very hard puzzle, or*
- *b) because you worked on it carefully?*

10. If a boy or girl tells you that you are dumb, is it more likely that they say that
- *a) because they are mad at you, or*
- *b) because what you did really wasn't very bright?*

11. Suppose you study to become a teacher, scientist, or doctor and you fail. Do you think this would happen
- *a) because you didn't work hard enough, or*
- *b) because you needed some help, and other people didn't give it to you?*

12. When you learn something quickly in school, is it usually
- *a) because you paid close attention, or*
- *b) because the teacher explained it clearly?*

13. If a teacher says to you, "Your work is fine," is it
- *a) something teachers usually say to encourage pupils,or*
- *b) because you did a good job?*

14. When you find it hard to work arithmetic or math problems at school, is it
- *a) because you didn't study well enough before you tried them, or*
- *b) because the teacher gave problems that were too hard?*

15. When you forget something you heard in class, is it
- *a) because the teacher didn't explain it very well, or*
- *b) because you didn't try very hard to remember?*

16. Suppose you weren't sure about the answer to a question your teacher asked you, but your answer turned out to be right. Is it likely to happen
- *a) because she wasn't as particular as usual, or*
- *b) because you gave the best answer you could think of?*

17. When you read a story and remember most of it, is it usually
- *a) because you were interested in the story, or*
- *b) because the story was well written?*

18. If your parents tell you you're acting silly and not thinking clearly, is it more likely to be
- *a) because of something you did, or*
- *b) because they happen to feel cranky?*

19. When you don't do well on a test at school, is it
- *a) because the test was especially hard, or*
- *b) because you didn't study for it?*

20. When you win at a game of cards or checkers, does it happen
- *a) because you play real well, or*
- *b) because the other person doesn't play well?*

21. If people think you're bright or clever, is it
- *a) because they happen to like you, or*
- *b) because you usually act that way?*

22. If a teacher didn't pass you to the next grade, would it probably be
- *a) because she "had it in for you", or*
- *b) because your school work wasn't good enough?*

23. Suppose you don't do as well as usual in a subject at school. Would this happen
- *a) because you weren't as careful as usual, or*
- *b) because somebody bothered you and kept you from working?*

24. If a boy or girl tells you that you are bright, is it usually
- *a) because you thought up a good idea, or*
- *b) because they like you?*

25. Suppose you became a famous teacher, scientist, or doctor. Do you think this would happen
- *a) because other people helped you when you needed it, or*
- *b) because you worked very hard?*

26. Suppose your parents say you aren't doing well in your school work. Is this likely to happen more
- *a) because your work isn't very good, or*
- *b) because they are feeling cranky?*

27. Suppose you are showing a friend how to play a game and he has trouble with it. Would that happen
- *a) because he wasn't able to understand how to play, or*
- *b) because you couldn't explain it well?*

28. When you find it easy to work arithmetic or math problems at school, is it usually
- *a) because the teacher gave you especially easy problems, or*
- *b) because you studied your book well before you tried them?*

29. When you remember something you heard in class, is it usually
- *a) because you tried hard to remember, or*
- *b) because the teacher explained it well?*

30. If you can't work a puzzle, is it more likely to happen
- *a) because you are not especially good at working puzzles, or*
- *b) because the instructions weren't written clearly enough?*

31. If your parents tell you that you are bright or clever, is it more likely
- *a) because they are feeling good, or*
- *b) because of something you did?*

32. Suppose you are explaining how to play a game to a friend and he learns quickly. Would that happen more often
- *a) because you explained it well, or*
- *b) because he was able to understand it?*

33. Suppose you're not sure about the answer to a question your teacher asks you and the answer you give turns out to be wrong. Is it likely to happen
- *a) because she was more particular than usual, or*
- *b) because you answered too quickly?*

34. If a teacher says to you "Try to do better," would it be
- *a) because this is something she might say to get pupils to try harder, or*
- *b) because your work wasn't as goos as usual?*

Wright State
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July 31, 1990

Ms. Cynthis Blackman
Chartered Psychologist
Edmonton Computest Psychological
Consulting Services LTD.
Suite 308
11523 - 100 Avenue
Edmonton, Alberta T5K 0J8

Dear Ms. Blackman:

This is to confirm the fact that you had my permission to use the Intellectual Achievement Responsibility scale (Crandall, Katkovsky, & Crandall, 1965) in your dissertation research. I look forward to hearing about your findings when you have them written up. Please note that we have moved; further correspondance should be sent to the new address on this letterhead.

Cordially,

Virginia C. Crandall

Virginia C. Crandall
Fels Professor in Psychiatry
Chief, Division of Developmental
Psychology

VCC:kc

APPENDIX J

THE CRANIOMANDIBULAR INDEX

CMI/SSI SCORING

Patient I.D.__________ Date:__________

Recall Week:__________

CMI Scores

DI = ___ + ___ + ___/26 DI = MM + TN + TP / 26 (# of positive responses)

MM _____

TN _____

TP _____

DI = _____

PI = ___ + ___ + ___/36 PI = EP + IP + NP / 36

EP _____

IP _____

NP _____

PI = _____

CMI = ___ + ___/2 CMI = PI + DI / 2

TOTAL CMI _____

SSI Score

$SX = \frac{\_\_\_}{5.8}$ (from question #30 - number of positive responses)

= ___

FR __.__ cm SSI = $\underline{\quad + \quad + \quad + \quad + \quad + \quad}$/60

DU __.__ cm

SI __.__ cm

AI __.__ cm $\underline{\text{SSI = FR + DU + SI + AI + TO + SX}}$/60

TO __.__ cm

TOTAL SSI = _____

Muscle and joint palpation

Right			> < =	Left	
Pos. (1)	Neg. (0)			Pos. (1)	Neg. (0)
____	____	Muscle: extraoral jaw			
____	____	Anterior temporalis	____	____	____
____	____	Middle temporalis	____	____	____
____	____	Deep masseter	____	____	____
____	____	Posterior temporalis	____	____	____
____	____	Anterior masseter	____	____	____
____	____	Inferior masseter	____	____	____
____	____	Posterior digastric	____	____	____
____	____	Medial pterygoid	____	____	____
____	____	Vertex	____	____	____
		Muscle: intraoral jaw			
____	____	Lateral pterygoid	____	____	____
____	____	Medial pterygoid	____	____	____
____	____	Temporalis insertion	____	____	____
		Muscle: neck			
____	____	Superior sternocleidomastoid	____	____	____
____	____	Middle sternocleidomastoid	____	____	____
____	____	Inferior sternocleidomastoid	____	____	____
____	____	Insertion trapezius	____	____	____
____	____	Upper Trapezius	____	____	____
____	____	Splenius capitis	____	____	____
____	____	Suprahyoids	____	____	____
____	____	Infrahyoid	____	____	____
____	____	Scaleni	____	____	____
____	____	Prevertebrals	____	____	____
____	____	Paravertebrals	____	____	____
		TMJ			
____	____	Lateral capsule	____	____	____
____	____	Posterior capsule	____	____	____
____	____	Superior capsule	____	____	____

Stomatognathic function and the Dysfunction Index

POS (1)	NEG (0)	**Mandibular movement (MM)** (Normal values in parentheses)
___	___	Maximum opening (incisor to incisor) ______ mm (40-60)
___	___	Passive stretch opening ______ mm (42-62)
___	___	Restriction
___	___	Pain on opening
___	___	Jerky opening
___	___	"S" deviation on opening (≤ 2mm)
___	___	Lateral deviation on opening (≤ 2mm)
___	___	Protrusion pain
___	___	Protrusion limitation ___mm (≥ 7mm)
___	___	Right laterotrusion pain
___	___	Right laterotrusion limitation ___mm (≥ 7mm)
___	___	Left laterotrusion pain
___	___	Left laterotrusion limitation ___mm (≥ 7mm)
___	___	Clinically can lock open (subluxate) ___right ___left
___	___	Clinically can or is locked closed (no translation) ___right ___left
___	___	Rigidity of jaw on manipulation

_____ MM TOTAL

TMJ noise (TN) (Check no more than two on each side)

(Right)			(Left)	
___	___	Reciprocal click (reciprocal elim. w/mandibular repositioning)	___	___
___	___	Reproducible opening click	___	___
___	___	Reproducible laterotrusive click only	___	___
___	___	Reproducible closing click	___	___
___	___	Nonreproducible click	___	___
___	___	Crepitus (fine)	___	___
___	___	Crepitus (coarse)	___	___
___	___	Popping	___	___

_____ TN TOTAL

_____ DI TOTAL
(MM + TN/2)

Description of each item for mandibular movement

Item	Description
Maximum opening	Measure from incisor to incisor at the midline (from No. 8 to No. 25)
Passive stretch opening	Gentle stretching by examiner beyond voluntary maximum opening
Restriction	Positive if maximum opening is less than 40mm or according to subjective opinion of examiner
Pain on opening	Pain with stretch or with maximum opening (not pressure or tightness)
Jerky opening	Not a smooth and/or continuous opening
S-deviation on opening	S-curve on opening or closing (positive if ≥ 2mm from midline)
Lateral deviation on opening	Lateral deviation at full opening (positive if ≥ 2mm from midline)
Protrusive a. Pain	Teeth are in light contact at end of range of motion. Any discomfort (but not pressure or tightness) during or at maximum protrusive is considered positive.
b. Limitation	Positive if less than 7mm (measured between labial surfaces of maxillary incisors at maxillary midline).
Right laterotrusion a. Pain b. Limitation	Same as protrusive
Left laterotrusion a. Pain b. Limitation	Same as protrusive
Clinically can lock open	Voluntary or involuntary forward dislocation of the condylar head out of the glenoid fossae combined with fixation in that position (no time specified)
Clinically can or is locked closed	Voluntary or involuntary blocking of short or permanent duration (fixation) of the mandible during opening
Rigidity of jaw upon manipulation	Resistance to manual rotation of jaw, voluntary or involuntary

Description of each item for TMJ noise

Item	Description (noise is eigher audible by patient, stethoscope, or palpable by examiner)
Reciprocal click	Noise made on opening and closing from centric occlusion position that is reproducible on every opening and closing. Can be eliminated with anterior repositioning of jaw.
Reproducible opening click	Noise with every opening, no noise when closing.
Reproducible laterotrusive click only	Noise with every full laterotrusive movement, no noise on opening.
Reproducible closing click	Noise with every closing, no noise when opening.
Nonreproducible click	Present on opening or in laterotrusion but not repeatable.
Crepitus (fine)	Fine grating noise suggestive of mild bone-on-bone contact.
Crepitus (coarse)	Coarse grating noise suggestive of gross bone-on-bone contact.
Popping	Distinctly audible sound on opening.